THE ROLE OF COMPLEX INSTRUCTION IN THE PURSUIT OF LEARNING GOALS: IT'S A MARATHON, NOT A SPRINT

by

Maggie Hackett

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by Maggie Hackett, titled The Role of Complex Instruction in the Pursuit of Learning Goals: It's a Marathon, Not a Sprint and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

Marcy B. Wood

Dissertation Chair - Marcy B. Wood Date: (***04/28/19***)

Kristin L Gunckel

Dissertation member - Kristin L. Gunckel Date: (***04/28/19***)

Marta Civil

Dissertation member - Marta Civil Date: (***04/28/19***)

Dissertation special member - Mathew D. Felton-Koestler Date: (***04/28/19***)

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Marcy B Wood

Marcy B. Wood Date: (***04/28/19***)
Associate Professor
Teaching, Learning, & Sociocultural Studies

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You helped consume the bottles of wine - oh, so many bottles.

(And let's be honest, it wasn't just wine.)

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To You,

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ABSTRACT

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By

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Despite a long-standing call in mathematics education for more student-centered teaching practices, instruction in the K-12 classroom is difficult to shift. Research on professional development experiences provide some insight into why teaching practices persist, but they do not tell the entire story. It is well documented that teachers' beliefs, learning goals, and instructional contexts also factor into the decisions teachers make about their practices. The research outlined in this study focused on making sense of these factors, as teachers contemplated changes to their instructional practice to incorporate Complex Instruction. Using a case study approach, I observed three elementary teachers during their mathematics lessons over the course of a semester. I interviewed them prior to and after the instruction to document what connections they made between their beliefs and goals to their anticipated and enacted practices. Analyzing the data through the lens of practicality theory, teachers' considerations were categorized according to the instrumentality, congruence, and cost of enacting Complex Instruction. Findings showed that teachers were able to bridge their current practices towards an idealized version of Complex Instruction, in an effort to better meet their goals. An alignment along the congruence dimension of practicality theory seemed to most impact the teachers' ability and willingness to adopt the practices. Lastly, the process of making changes to instructional practice takes an incredible amount of time. The findings of this study can inform those who support teachers as they work to align beliefs, goals, and practices.

CHAPTER 1

INTRODUCTION

As an instructional coach in the public-school setting, one of my favorite responsibilities was introducing teachers to innovations and strategies that research had proven to be effective in the teaching and learning of mathematics. Early in my coaching career, I facilitated a teacher study group with elementary school teachers around the concept of Complex Instruction (CI).

CI is a particular set of instructional practices that focuses on norms, roles, and groupworthy tasks in an attempt to equalize status effects that impact students' access to learning (Cohen, 1994; Featherstone et al., 2011). As the influence of status is reduced in the classroom, the focus becomes more on mathematical reasoning, rather than on who is smartest in mathematics, allowing more students access to the learning (Featherstone et al., 2011). Norms and roles encourage participation from all members, resulting in a product that is a reflection of all students' combined efforts, as opposed to attributed to any singular student (Cohen, Lotan, Abram, Scarloss, & Schultz, 2002). When students see that group members have a variety of skills and insights to offer this helps dispel the belief of the existence of "math people" and "non-math people."

The teacher study group I facilitated spanned a calendar year, with the spring semester focused on teachers learning about CI, and the fall semester being an implementation phase. During a spring semester, eleven elementary teachers participated in a teacher study group where they engaged in tasks that allowed them to learn about the tenets of CI, and they enacted various components of the innovation in their classrooms with their students. During the bi-monthly meetings, the discussions were overwhelmingly positive. The teachers commented on how they could envision the CI culture benefitting their students' understanding of mathematics. The

elementary school teachers also noted how the structures of CI would free them up to better meet the needs of all their students. There was a high level of excitement at the idea of implementing CI in the fall semester of the upcoming school year.

The following fall semester started with a few refresher meetings to remind the teachers of their previously devised plans to implement CI. The teachers planned a soft rollout, during which time they would introduce their students to the norms of groupwork, as well as the individual roles that students would hold throughout the year. More academically challenging groupworthy tasks would come after norms and roles were established. And then they went into their classrooms and closed their doors.

We met as a group, twice a month throughout the fall semester, to share progress and struggles during the fall implementation phase. As the semester unfolded, the conversations revealed that the teachers had made little headway creating classrooms where CI was the norm. The elementary teachers stated that they had not had time, that they needed to establish their classroom procedures first and then they could focus on the CI procedures, and that they weren't sure they could relinquish control to this group of students. Given the enthusiasm that was evident during the previous spring, I was perplexed at the resistance that was now apparent.

I adjusted my expectations. I facilitated learning experiences for the teachers that would highlight the benefits of teaching and learning through the CI lens. I offered support in the form of modeling, co-teaching, and planning. We made it through the semester with each teacher engaging with the CI practices to varying levels, but not to the level I had anticipated - and I had no idea what had gone wrong.

Beyond the scope of my small teacher study group, millions of dollars and countless hours are invested annually into teacher professional development (PD). Yet we know from

research (Borko, 2004; Garet et al., 2010; Yoon, Duncan, Lee, Scarloss, & Shapely, 2007) that much of this professional development fails to change teachers' instructional practices. I wanted to learn more about what factors support or interfere with teachers' decisions on whether or not to take up new instructional practices. I wanted to better understand the complexities that drive these instructional decisions. This dissertation is an exploration of my making sense of teachers' considerations as they contemplate changes to their instructional practices, through a research lens I have found to be practical. In the next sections, I will provide a statement of the problem and then outline the dissertation chapters.

Statement of the Problem

CI is just one example of the type of student-centered teaching practices that has been called for in mathematics classrooms over the last three decades (NCTM, 2014; Schoenfeld, 2004). Reform teaching practices highlight the need for teachers to provide students with mathematical tasks that support and develop reasoning and problem solving skills (Boaler & Staples, 2008; Carpenter, Fennema, Franke, Levi, & Empson, 1999; Grant, Hiebert, & Wearne, 1998). Student discourse is encouraged as a sense making strategy while students work on tasks (Chapin, O'Connor, & Anderson, 2003; Kazemi & Hintz, 2014; Stein & Smith, 2011). The use of student discourse around problem-based mathematical tasks helps students build and develop their procedural fluency from their conceptual understandings (Carpenter, et al., 1999; CCSSM, 2010). While there have been some in-roads made in regards to teachers adopting these reform teaching practices, there is still much work to be done (NCTM, 2014). Given the amount of time, money, and human resources schools invest in teachers' instructional practices, for the purposes of positive student outcomes, it seems essential to explore why the progress made in

adopting reform teaching practices has been less than expected. My experience with the teacher study group was not unique.

Many educational researchers have looked to PD events that teachers experience, in an effort to identify what works well and what hinders teachers' implementation of suggested practices. Changes to teachers' instructional practices is a gradual and difficult process (Borko, 2004; Guskey, 1986). A substantial investment of time has been shown to be most effective in terms of teacher impact (Doerr, Goldsmith, and Lewis, 2010; Heck, Banilower, Weiss, & Rosenberg, 2008; NCTM, 2014). In addition to time, basing PD within the teachers' instructional contexts, as well as structuring the PD in a cycle of model, enact, reflect, and repeat, has resulted in substantial positive changes to teachers' instructional practices (Borko, Mayfield, Marion, Flexer, & Cumbo, 1997; Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Grant et al., 1998). While the PD experience I provided the teachers in the study group was not without flaws, it had been intentionally structured to address many of the identified shortcomings of PD from the research literature. Further examination of the PD experience would most likely not be helpful in answering my questions. I needed a way to analyze what happened when the teachers went into their classrooms and closed their doors.

During the spring semester of the teacher study group, I was enrolled in a curriculum theory and policy course. About halfway through the semester the topic for the evening was events and practicality; a seemingly innocuous and vague topic. However, from that evening came the theory and framework of analysis that will be used in this dissertation, practicality theory (Doyle & Ponder, 1977).

> The theory is, therefore, at the nexus of the troubled relationship between pedagogical innovation and classroom practice, and represents a view that the frequent disparity

> between what innovators intent and teachers enact is not a barrier to be vigorously overcome but a site for systemic analysis and invention. (Janssen, Westbroek, Doyle, & Van Driel, 2013, p. 3).

My frustration abated as Doyle outlined instrumentality, congruence, and cost, the three dimensions by which one might analyze the factors of consideration in adopting innovations. I was informally mapping teacher comments and actions to the three dimensions, as practicality theory was explained to be a means to understand why suggested innovations did not often result in expected outcomes.

This seemed to be a particularly helpful tool in helping me, as a teacher educator and mathematics education researcher, make sense of teachers' practices once they are in the enactment stage. Because the practice of CI is particularly complex, it would be helpful to examine teachers' enactment through a lens that could handle the complexity.

Overview of the Dissertation

In Chapter 2, I elaborate on the theoretical framework already outlined. I begin with an introduction to teachers' persistence of practice. I describe several of the factors that contribute to teachers' decisions regarding their instructional practice, include professional development, teacher's beliefs, and their instructional goals. I then describe the particular instructional practice featured in this dissertation, Complex Instruction. Finally, I lay out practicality theory as a way to analyze teachers' adoption of Complex Instruction.

Chapter 3 is where I describe my methods for this research study. I describe the context of the research, including the setting and focal participants. I also take care to outline my positionality in respect to the context and this research. Next I outline what data I collected, how it was analyzed, and the limitations created by my research methods.

In Chapters 4 through 6, I present my findings in a presentation of a case of each individual teacher. First, I describe the teacher's understanding of CI at the start of the study. I then discuss instructional decisions the teacher made throughout the course of the study, which is analyzed through the lens of practicality theory. I then return to the teacher's understanding of CI, as a way to measure the growth they might have made in their process of enactment throughout the semester. Each chapter concludes with a discussion that makes connections between the dimensions of practicality theory and the teacher's instructional decisions.

Chapter 7 is a cross-case analysis, where I discuss my findings across the three case studies, and apply an analysis through the lens of practicality theory's three dimensions. I end with an overall discussion and conclusion in chapter 8 I discuss assumptions and contributions in regards to practicality theory and Complex Instruction. I end with a discussion about limitations of this research and what might be next steps in regards to this research.

CHAPTER 2

LITERATURE REVIEW

In this chapter, I will present an approach for analyzing how and why teachers take up Complex Instruction (CI). I will discuss how Doyle & Ponder's (1977) practicality theory can be a useful lens for analyzing the process teachers undergo as they grapple with enacting this particular innovation. I will start with background on what we know regarding teachers persistence of practice, specifically in terms of professional development (PD), teacher beliefs, and teachers' learning goals. I will then introduce CI and highlight existing examples of enactment. Finally, I will introduce practicality theory and describe why it might be a helpful analytical tool in the particular case of teachers adopting and adapting CI.

Teachers' Persistence of Practice

> The new visions of learning and teaching underlying educational reform are making profound demands on teachers. If they are to move successfully towards these visions, many teachers-experts and novices alike-must make major changes in their teaching practices, as well as in their knowledge and beliefs about teaching, learning, and subject matter. (Borko et al., 1997, p. 260)

The mathematics education reform movement gained traction in large part due to NCTM's publications of *Curriculum and Evaluation Standards for School Mathematics* (1989) and the *Professional Standards for Teaching Mathematics* (1991). At that time, the Educational Testing Service stated that rhetoric regarding instructional innovation surpassed the reality of actual changes in the typical classroom (Goldenberg & Gallimore, 1991). More recent mathematics education research conducted in various classrooms across the United States has led to the conclusion that the reform movement has not resulted in widespread changes to instruction

(Andrew, 2007; Philipp, 2007). While there are "pockets of excellence", mathematics education is not systemically in a position to positively impact the learning of all students (NCTM, 2014, p. 3). Regardless of the fact that each year brings a new educational buzz word, spurred on by recently published policies or research, it seems as though very little changes at the core of teachers' instructional practices.

Do not misunderstand; no singular system of teaching is necessary for positive student learning outcomes (Hiebert et al., 2005). There are numerous successful instructional practices, as exemplified by classrooms around the world, including many examples here in the United States (Butman, 2014; Coomes, 2018; Willingham, Strayer, Barlow, & Lischka, 2018). However, many teachers hold on to ineffective instructional routines, regardless of reported poor achievement outcomes for students. This is not to say that teachers intentionally provide a disservice to their students. We must operate under the positive presupposition that most teachers are intrinsically motivated to refine their craft in order to affect positive change for students' learning (Guskey, 1986). In an effort to be more of service to teachers in their pursuit of positively impacting student learning, we need to better understand what might motivate teachers to cling to, as well as refine, their craft.

Researchers have studied the good, the bad, and the ugly of PD, due to the influential role it plays in impacting teacher practices. The historical beginnings of PD were associated with chaos and criticism (Guskey, 1986). It is arguable, the scene has not undergone ample improvement over the last century. Much of the PD available to teachers is considered inadequate, and not usually as influential as we might hope. It is viewed as having little value to teachers and has limited impact on their instruction, as well as on student achievement (Borko, 2004; Garet et al., 2010; Yoon et al., 2007). Despite the inadequacy that accompanies many PD

experiences, the following characteristics have been identified to be essential in positively impacting teachers' practice: content-focused, incorporates active learning, supports collaboration, uses models of effective practice, provides coaching and expert support, offers feedback and reflection, and is of sustained duration (Borko et al., 1997; Foster, 2017; Heck et al., 2008; Patton, Parker, & Tannehill, 2015).

The existing research provides a roadmap for what constitutes effective PD, but simply providing it is not enough. In the complex environment of their classroom, teachers do not easily alter or discard practices they have developed and refined, even after presented with evidence from the most carefully designed research studies (Bolster, 1983, as referenced in Guskey, 1986). Teachers take their learning and experience into their classrooms and from there, it is up to them. We do not know what is really happening in classrooms as teachers consider implementation of ideas from PD. We still do not understand other factors involved in the decision to implement PD. We clearly need to know much more about what happens after PD, in classrooms. When teachers leave PD feeling ready to make changes, what happens to undermine that innovation energy?

Research suggests that we need to consider knowledge, beliefs, affect, and goals. A significant focus of mathematics education research has been on studying teachers' knowledge, beliefs, and affect related to mathematics teaching, in an attempt to reveal the connections between these constructs and teachers' instructional practices (Philipp, 2007). Likewise, there is a large body of research on teachers' learning goals in relation to their practices. These topics will be addressed to establish a history of teachers' persistence of problematic practice in relation to these central ideas. In the following sections, I will outline several explanations for teachers' persistence in their mathematics instructional practices. First, I will focus on the intersection

between PD and teacher beliefs. Next, I will share some of the research done regarding teachers' learning goals and how that interplays with their application of PD learnings.

Teachers' Beliefs

Due to the number of unique perceptions, as well as to an inconsistent use of terms, a single definition of beliefs has not yet been agreed upon in the research literature (Fives & Buhel, 2012). As a construct, a working definition is the various lenses through which one interprets the world. This psychological basis affords each individual unique understandings, principles, or ideas about what they know to be true (Philipp, 2007). Within the context of education there can be as many varying beliefs about teaching and learning as there are stakeholders. Because of individual experiences, particular ideas have formed about what school is, what it should look like, and what are the intended outcomes.

While a precise definition remains elusive, Philipp (2007) identified four characteristics of beliefs. First, they influence one's perception. Beliefs serve as a filter to interpret the world around us. The perception a teacher has regarding their teaching context and their students is influenced by their beliefs. Their beliefs will factor in to their determination of how practical certain instructional practices are deemed to be. A teacher might not change their instruction because they do not perceive a disconnect between their beliefs and their practices, based on how they filter incoming information.

Secondly, beliefs predispose a person toward a particular direction. When beliefs are aligned with settings, characters, events, and ideas, they seem more attractive than those that run counter to one’s ecology or environment. Essentially, like seeks like. This characteristic of beliefs from Phillip (2007) seems to speak to the congruity of a proposed innovation. For example, a teacher who subscribes to reform-oriented instructional practices is unlikely to invest

in practices that support a teacher-centered model of instruction. Their beliefs would steer them towards practices which reinforced their inclinations.

Next, beliefs are not all-or-nothing entities. They are held with varying intensities that might fluctuate based on context, which can create competing hierarchical beliefs that teachers must contend with. Philipp (2007) claimed some beliefs were more central or primary, and therefore played a greater role in influencing a teacher's instructional practice. Along with central and primary beliefs, Fives and Buehl contend "that teachers hold both implicit and explicit beliefs that influence their teaching practice." (2012, p. 474). As an exemplar of this idea, Raymond's study (1997) focused on a teacher's perspective to help explain an apparent contradiction between their own beliefs and practices. In this study, the teacher viewed her mathematics teaching practice in terms of what she wanted to do, or thought she should do, rather than what she actually did. In reality, her practice was more closely related to her beliefs about mathematics content than to her beliefs about mathematics teaching and learning. Since the teacher's beliefs about content had more influence on her practice, they might be considered more primary for that teacher. Other conflicting beliefs might have been held but did not seem to influence the teacher's practice.

Lastly, beliefs tend to be context specific, and are therefore qualitatively different when enacted in various contexts (Lerman, 2001; Philipp, 2007). For example, a teacher might hold a set of beliefs and corresponding instructional practices during state standardized assessment season that differs from the rest of the school year. Although they recognize a connection between teachers' beliefs to a specific context, Fives and Buehl (2012) counter Lerman and Phillip with the perspective that beliefs are held by individual teachers and stay with them as they move in and out of different contexts. "Rather than perceiving beliefs as existing in

situations, we contend that different situations or contexts may activate specific beliefs that influence the teachers' understanding and actions" (Fives & Buehl, 2012, p. 476). Regardless of whether one subscribes to the idea of beliefs being contextually or individually grounded, there is little doubt that they are intertwined with instructional practices and the decisions one makes regarding which practices to enact. This entanglement of beliefs and instructional practices is further complicated by the content of particular beliefs one holds. In the next sections, I will briefly outline some of those variations, in terms of beliefs about teaching and learning mathematics, as well as beliefs about students.

Origins of beliefs about teaching and learning mathematics. Experience is at the core of teachers' beliefs about mathematics teaching and learning. The nature of this experience can be personal, related to schooling and instruction, and linked to formal knowledge (Richardson, 1996). Personal beliefs related to one's perception of their place in the world, the relationship they discern between school and society, and their own cultural sensitivities all impact their beliefs about mathematics teaching and learning.

Teachers also bring with them into their classrooms their own experiences with school as students (Lortie, 1975). These beliefs about what defines teaching and learning tend to persist until experience as an educator provides alternative points of view. Guskey (1986) concluded, teachers' beliefs and attitudes about teaching and instructional practices are largely derived from their classroom experience. A teacher who has been unsuccessful in helping educationally disadvantaged students attain high levels of academic achievement is more likely to develop beliefs that students of this background are incapable of academic excellence. Prior experience with particular types of students and contexts tends to create a reinforcing cycle of instructional practices, especially when it comes to minority students and students from low-income

communities, as these students are often not seen as competent knowers and doers of mathematics (e.g., Martin, 2009). Conversely, a teacher who has experienced success teaching students of a variety of backgrounds might not develop such beliefs. Guskey (1986) claimed, if a teacher tried a new instructional strategy, and experienced success in helping students achieve academically, that teacher's beliefs would likely change, making them open to other innovations.

Lastly, beliefs about teaching and learning stem not only from one's formal and informal knowledge of mathematical content, but also one's pedagogical content knowledge (Richardson, 1996). One's beliefs about mathematics can be closely tied to their own confidence with the subject and enjoyment of the discipline. Those who had lower self-confidence and enjoyed mathematics less, generally held beliefs about teaching and learning that aligned with traditionalist viewpoints (Stipek, Givvin, Salmon, & MacGyvers, 2001). Being more reform-oriented generally indicated a higher level of comfort and contentment with mathematics.

The impact of beliefs on practices. Beliefs about mathematics teaching and learning influence teachers' pedagogical decisions and classroom practices (Beswick, 2012). Less confident teachers are drawn to a set of beliefs and practices that require relatively less teacher judgement and decision-making. Focusing on procedures and correct answers allows one to teach in a prescribed way. Teachers who focus on students' own or socially constructed understandings of mathematics need to analyze the meaning of the students' errors and strategies (Stipek et al., 2001). A teacher who believes mathematics activities serve as computation practice will enact different instructional strategies from a teacher who believes the activities should enable students to engage with open-ended contextual situations.

Teachers in the United States were found to employ a unique system of teaching in the TIMSS video study (Heibert et al., 2005), not because of any particular feature, but because of a

collection of instructional practices that ultimately reinforced attention to lower-level mathematics skills. Perhaps the instructional practices were influenced by teachers' beliefs about what it meant to learn mathematics. Perhaps the instructional practices were influenced by the teachers' own mathematical content knowledge. Perhaps both. The intertwined relationship of knowledge and beliefs can make fundamental changes in teaching practices difficult to achieve (Borko et al., 1997), but can have a powerful impact on student outcomes.

In spite of particular perceptions about the way students can and should be taught mathematics, there are instances in which tension between competing beliefs influences teachers' instructional practices. Sztajn (2003) reported on how different teachers' beliefs about their students impacted their mathematical practices in different ways. One teacher believed students should engage in problem solving to develop higher order thinking skills. However, she also believed that, because her students came from unstable, chaotic homes, they needed foundational skills for their future endeavors like basic facts, drills, and practice. The instructional routines for these students was not congruent with the teacher's beliefs about mathematics, but rather with her beliefs about the students themselves. Sztajn (2003) contrasted this teacher with another, who held similar ideals about mathematics but varied in her belief of students' needs. This second teacher's instruction focused little on rote basics. Because she felt her students exhibited few behavioral problems, she felt the freedom to structure her classroom around problem solving and projects. While both teachers valued problem-based instruction, their contrasting beliefs about their students and society resulted in very different mathematics instructional practices.

Research shows the complexity of the relationship between practices and beliefs. Throughout the course of Carpenter et al.'s (1989) longitudinal study of Cognitively Guided Instruction (CGI), teachers' beliefs and practices underwent large changes when teachers learned

about children's mathematical thinking. CGI was a PD program focused on helping teachers understand the development of children's mathematical thinking. Carpenter et al. (1999) formally studied changes in the beliefs and instructional practices of the teachers (as well as students' learning growth), through administration of a beliefs survey. The forty-eight question Likert-scale survey included items that measured various teachers' beliefs, such as the belief that children should construct their own knowledge in lieu of being passive receivers, the belief that children's development should guide instructional sequence, and the belief instruction should facilitate children's construction of knowledge through problem solving and not consist of teachers' solely presenting isolated skills. After participating in the extended PD program, results from a beliefs survey showed that teachers who were involved in the PD were more cognitively guided in their beliefs about students as compared to the teachers in the control group. However, the researchers could not find a generalizable relationship between change in beliefs and change in instruction. The relationship between the two constructs was found to be too complex and could only be understood in terms of specific teachers. In a follow-up study, four years after the completion of the CGI project, Knapp and Peterson (1995) reported the teachers' beliefs in CGI principles deepened over time as students generated solutions to complex mathematical problems. This implied that a change to teachers' beliefs is not an event, but rather a process, which gains momentum as teachers see students achieve academic success.

Shifting unproductive beliefs in service to reform-oriented practices. Despite numerous attempts to highlight the benefits of reform-oriented, participation-centered instructional practices (e.g. NCTM, 1991; NCTM, 2014; Schoenfeld, 2004), a transmission belief of teaching still dominates the mathematical learning process in classrooms across the United States (Polly et al., 2013; Stipek et al., 2001; Wood, Cobb, & Yackel, 1991). Ross,

McDougall, & Hogaboam-Gray (2002) concluded that the main obstacle in implementing reform-oriented practices was teachers' beliefs about mathematics teaching and learning. When these beliefs "hinder the implementation of effective instructional practice or limit student access to important mathematics content or practices" (NCTM, 2014, p. 11), NCTM has labeled them as unproductive beliefs. Unproductive beliefs about teaching and learning mathematics frequently leads to instructional practices that merely convey mathematics as a set of rules and procedures, rather than teaching that lends itself to fostering inquiry and conceptual understanding (Wood et al., 1991). The pervasiveness of these unproductive beliefs tend to pose strong barriers to change (Francis, Rapacki, & Eker, 2015). Unproductive beliefs need to be addressed in an effort to effect a change towards more desired teaching practices. As teachers' beliefs about teaching and learning mathematics become more productive, they might be more inclined to implement reform-oriented practices, which then enables students to engage with mathematics in meaningful ways.

For example, Wood and colleagues (1991) offer a constructivist view of teaching, where teachers see students as active participants in their learning, as opposed to teachers treating students as passive receivers of knowledge, as is typical in a traditional instructional model. According to the constructivist view, learning of mathematics involves not only the psychological view that learners personally construct meaning to develop knowledge, but the sociological negotiation of learning as a shared activity. A computationally-oriented teacher might emphasize individualized work and unilateral conversations. The idea of whole-class discussions would be incongruent with this teacher's beliefs about what mathematics teaching and learning is, and might threaten their identity as a mathematics instructor. Probing this idea further, this speaks more to the idea that one might hold conflicting beliefs. A belief about what

math is might override a belief about good teaching strategies. This might be more the idea of one belief overriding another, and not an incongruence among beliefs.

Beliefs can change as teachers encounter conflicts in their belief systems. In their classroom case study, Wood et al., (1991) found, as a second-grade teacher implemented new instructional practices, the teacher's beliefs about teaching, learning, and mathematics itself became more congruent with constructivism as a construct. Wood and colleagues concluded this teacher's change in practice occurred as she recognized her role of transmitting mathematical information and rules conflicted with what she was being asked to implement with the constructivist model. This led to a realization that her current procedures were hindering students' meaning making. The teacher developed practices that encouraged students to construct mathematical concepts and operations. The teacher concluded that the cost/benefit ratio of implementing the reform instructional practices was worth it, given that both her own and her students' mathematical knowledge increased far greater when compared to previous practices.

Primary driver: Instructional practices or teachers' beliefs. Guskey (1986) identified three major outcomes for PD: change in practice, change in beliefs, and change in student outcomes. The order in which to address these consequences seemed a point of contention in the literature. Guskey (1986) claimed that flawed PD designs focused on changing beliefs before instructional practices. He posited through observation and other activities designed to support teacher learning and implementation of practice, such as reflection and group discussion, teachers' beliefs would shift towards acceptance of the new instructional practice (Guskey, 1986; Philipp, 2007).

The contrasting debate implied, without an initial change of beliefs, a teacher would resist a new practice or innovation. Given that beliefs serve as filters that affect perception, many

have difficulty seeing what they do not already believe (Grant, et al., 1998; Pajares, 1992; Stipek et al., 2001). When teachers perceived their beliefs more as knowledge, defined as irrefutable fact, rather than as a filter through which to interpret conceptions, their instructional practices became static. For example, Stipek at al. (2001) found a relationship between teachers' beliefs about mathematics and their practices. For the teachers who felt mathematics was a set of operations to be learned, they tended to exercise complete control over mathematics activities. Teachers who believed mathematics was a tool for thought tended to provide students autonomy over their own learning experiences. Without an intervention for unproductive beliefs, new ideas are generally ignored or improperly incorporated into existing practices.

Teachers' beliefs systems are complex, much like the practice of teaching itself, and researchers have found that, at times, teachers hold beliefs that appear inconsistent with their teaching practices (Philipp, 2007). Beliefs about one's role as an educator, beliefs about what it looks and sounds like to learn, and beliefs about the system in which teacher and student engage are constantly influencing the instructional decisions in the classroom. In addition to practices being a visible indicator of beliefs about teaching and learning, identified goals for learning can provide insight into a teacher’s beliefs.

Learning Goals

Contributing to the lack of clarity in the research on teachers' beliefs and their instructional practices is the added element of a focus on learning goals. Goals specify the learning, (the understanding, knowledge, skills or application) that is intended within a lesson or unit of study (Heritage, 2016). Hiebert et al. (2005) claimed it was foolish to debate the merits of one system of teaching in comparison to others until specifying learning goals. Because goals should reflect the worthwhile learning in the course of a lesson, the ability to communicate a

learning goal indicates the learning is important and valued has been identified (Heritage, 2016). But learning goals can vary widely across classrooms and are usually influenced by how teachers define mathematics, teaching, and learning, which influences their beliefs (Cobb, 1986). If a teacher believes to do mathematics means to number crunch and memorize a series of formulas and algorithms, then their learning goals will most likely mirror those beliefs. If we want to make sense of the relationship between beliefs and practices, we must also take into consideration learning goals.

Learning goals identify important and valued learning (Heritage, 2016). Because *important* and *valued* are subjective, learning goals can vary widely across classrooms and contexts. The subjectiveness of these learning goals is in part due to an influence of teachers' beliefs about and definitions of mathematics, teaching, and learning. The instructional practices enacted will be those in support of the teachers' goals, based on their beliefs.

Goals played a pivotal role in the 1999 TIMSS Video Study that compared the educational practices of varying high-achieving countries with the United States (Hiebert et al., 2005). Through data analysis of particular practices, researchers concluded that higher achieving educational systems had alignment between learning goals, instructional practices, and the goals of assessment. This alignment allowed these educational systems to assess the success of instruction. Within the United States, goals and practices were disjointed, leading to an inefficiency in instruction, thereby having a weakened effect on student learning. Another fundamental aspect of successful educational systems studied was a cohesiveness among varying instructional features in an effort to promote students' achievement of particular learning goals (Hiebert et al., 2005). Teachers were more likely to attain their predetermined goals when the components of instruction worked together. When instruction was disjointed, it became more

difficult to attain learning goals. The conclusions drawn from the TIMSS study demonstrate just how crucial goals are to students' success in an academic setting.

And yet, in much of existing education research, learning goals might be regarded the middle child if you will, between a teacher's beliefs - about mathematics, teaching and learning, and their students - and the instructional practices that are enacted within a classroom context. Some argue goals are predicated on beliefs, developing from what one knows to be true. Others might say goals influence the context in which they are enacted, thus making practices the driving force, from which everything else falls into line. Let’s not take a stand either way, in another dichotomous fight that is ubiquitous in mathematics education. Instead, let's just briefly explore the two sides.

Learning goals impacted by beliefs. There is a delicate relationship between the beliefs one holds about teaching, learning, and students, which inform the identified learning goals, and the practices enacted in service of these goals and beliefs. Beliefs allow one to accept learning goals that might vary from those previously accepted as normative. Beliefs can create meaning and allow one to establish overall learning goals that specify general contexts. The act of articulating an instructional goal (and thereby identifying what is valued in the learning) immediately defines practices (in service to what is valued). The goal, as an expression of beliefs, symbolizes implicit anticipations and expectations about how a situation will unfold (Cobb, 1986). An instructional practice is grounded not only in the limitations set by the goal, but in the beliefs that initiated the goal.

Learning goals exemplify the beliefs one holds. For example, there is an underlying belief that mathematical skills should be taught in relation to understanding and problem solving. A contrasting belief might be that mathematical skills are discrete components and should be

taught in isolation from understanding and problem solving. Both viewpoints assert that skills, understanding, and problem solving are all important goals of mathematics instruction. However, they lend themselves to different practices as the most effective way to achieve these goals (Peterson , Fennema, Carpenter, & Loef, 1989). Thus different beliefs about what mathematics is can result in similar learning goals.

Yet, because of the foundational differences in beliefs, the instructional practices to enact these seemingly similar goals can be markedly different. In a study conducted by Grant et al. (1998), teachers held a mixed set of beliefs, viewing mathematics as skills and understanding, and identified with some of the goals of reform-minded instruction. These teachers faltered when they translated the goals into instructional practices. The goals became less about supporting students' learning, and more about the efficiency of completing the lesson. The challenge of keeping practices aligned with goals "relates to the needs of classroom teachers as they encounter a different emphasis in the goals of mathematics education and children's learning that, for most, requires a substantial change in the way they teach mathematics" (Wood et al., 1991, p. 611). This speaks to the notion that practices, rather than beliefs might be a driving factor in achieving set learning goals.

Learning goals impacted by context. When there are seemingly inconsistent connections between a teacher's beliefs and the practices they enact, one must consider the goal-directed contexts that frame the practices (Cobb, 1986). Teachers' contexts may influence the enactment of goals. What Cobb found true for students, might hold true for teachers, in the idea that social factors rather than mathematical factors, may gave rise to a reorganization of beliefs about mathematics. The misalignment between beliefs, goals, and practices might be socially

influenced by the teaching context, in a seeming backwards design, where the mitigating force behind learning goals is the context of the practice rather than the initiating belief.

Instructional context can influence the learning goals in a number of ways. Administrators, accountability systems, and even the students themselves might be responsible for this shifting of goals as a response to instructional practices. As Wood et al. (1991) reported in their case study of instruction occurring in a second grade classroom, one teacher recognized an incongruence between her prior goals for teaching and her instructional practices based on the children's responses to the activities. The idea of using student feedback to adjust instructional goals was also argued by Lampert (1986) who claimed that monitoring students' knowledge should relate to a teacher's goals for instruction. In the short-term, teachers might achieve learning goals without attending to students' knowledge, but in an effort to facilitate students' growth in understanding and problem solving long-term, teachers may need to understand students' thinking (Carpenter et al., 1989).

While teachers' beliefs, goals, and practices are clearly linked, very few studies (e.g. Cobb, 1986) have considered how the three work together to inform instructional decisions. By focusing on all three, we might gain a better understanding of the influence each has on the other in the classroom context. Similarly, while there has been some work around beginning teachers' beliefs and practices (Raymond, 1997), less research has focused on the relationships between more veteran teachers' beliefs and practices. Veteran teachers' experience in the classroom might mean their beliefs influence learning goals and practices in ways that differ from those of beginning teachers. This study aims to extend the work done by experts in the field, but to do so focusing on the specific instructional practice of CI.

Complex Instruction

There have been arguments that the current educational policy landscape, specifically in regards to the *Common Core State Standards of Mathematics* (CCSS-M) (CCSSI, 2010), lack explicit attention to issues of equity (Bartell et al., 2017). Time and time again, it has been shown that unproductive beliefs and discourses about students from non-dominant communities remain unchallenged. This is especially disconcerting in the realm of mathematics education as it serves as a gatekeeper to high school graduation and college entrance (Bartell et al., 2017; Gutstein, 2006; NCTM, 2014). As a standards documents there is not an inclusion of a description of specific instructional practices in the CCSS-M to support equitable student learning (Bartell et al., 2017). As is usual in education, there is a great divide between theory and policy and the actual enactment in the classroom. It is up to educators to bridge that divide. CI is an instructional practice that can do just that.

"Complex Instruction is a set of strategies for creating equitable classrooms. Using these strategies, teachers can teach to a high intellectual level in academically and linguistically heterogeneous classrooms" (Cohen et al., 2002, p. 1047). CI is a specific type of groupwork that focuses on norms, roles, and tasks in an attempt to equalize status effects that impact students' access to learning. CI has two key features as defined by Cohen (1994). First, authority is delegated to the students, positioning them as responsible for their learning. Instruction is shifted from teacher-centered to student-centered, from a direct-instruction model to an inquiry model. The second key feature of CI, is a developed sense of interdependence among the students towards the goal of completing a mathematical task (Cohen, 1994). This collaboration and shared learning among the students provides the space for an alternate definition of what it means to be smart in math. It allows students to show these smarts through creative problem

solving, conceptual learning, and increased oral proficiency (Cohen, 1994). The enactment of these features is dependent upon the equalization of status among the students.

In the following sections, I will outline the various components of CI, as well as share some of the existing research. Then, we will look briefly at the most notable documented case of an educational system who demonstrated success in their enactment of CI. Finally, we will circle back to why CI was selected as the innovation of focus for this study.

Status

The foundation of Complex Instruction is recognition of and work on status problems. Cohen defined status as "an agreed-upon social ranking where everyone feels it is better to have a high rank than a low rank" (1994, p. 33). Horn (2012) defined status as "the perception of students' academic capability and social desirability" (p. 21). This blend of the academic and social comes together when status is conferred based on characteristics that are non-academic in nature, such as race, language proficiency, or socio-economic status, but influence the perception of success on academic tasks. Additionally, academic performance in one content area can affect the perception of abilities in another. Often, students who are viewed as good readers tend to enjoy high status across the academic areas, regardless of their performance or abilities (Cohen, 1994; Featherstone et al., 2011; Horn, 2012).

Status falls in as a subset of the sociopolitical theories of mathematics instruction as outlined by Gutiérrez 45(2013). Instructional practices need to address detrimental assumptions of status in an effort to position all students in ways that give them access to mathematical learning and to develop their identities as mathematicians (Cohen & Lotan, 1995; Selling, 2016). As an example, Turner, Dominguez, Maldonado, and Empson (2013) studied moves teachers made that positioned Latinx English learners' to adopt problem-solving roles. They found when

teachers made explicit references to an EL's mathematical ideas, it validated their reasoning and positioned them as mathematicians. When teachers highlight students' intellectual contributions to the mathematical work, there is potential to challenge and disrupt damaging and systematic issues of status (Selling, 2016).

It is often quite easy to sort students in a classroom into those that have been assigned high status by their peers, and those who have been assigned low status (Horn, 2012). More often than not, the students are quite forthcoming in their opinions of their peers. In addition to verbal confirmation, participation can often be telling in terms of who has the benefit of being viewed as high status. Those students are privileged by having their ideas heard and valued. Non-verbal cues can also be helpful; body language, positioning of focus, and location and access of materials can convey perceptions of who has valuable ideas to contribute. Worth noting, assignment of status is not limited as a student to student interaction, but status can also be assigned or reinforced by teachers (Cohen, 1994).When particular students are more frequently called on to contribute, when expectations are blatantly skewed, or when group dynamics are structured in a way so there is clearly a balance of achievement by particular measures, the students take notice. It is almost as though the labels have been given a stamp of approval. As we work to reduce the influence of status in mathematics classrooms, through the implementation of norms, roles, and tasks, the focus shifts towards reasoning and access, as opposed to who is "smartest" (Featherstone et al., 2011).

Strategies can be embedded into the structure of tasks that might address status issues in the classroom. Rough-draft talk is one such strategy as shared by Jansen, Cooper, Vascellaro, and Wandless (2016), in an effort to encourage participation so all students may benefit from the knowledge each student brings to a task. As a way to work though understandings, students

engage in this iterative process which fosters intellectual risk taking and promotes the idea that mathematics learning is messy and not a quick process (Jansen, et al., 2016). When rough-draft talk is shared, the teacher is establishing a valuable part of the class's learning process. Once a routine is established as a part of the learning process, it opens up the space for more students to be positioned as mathematicians (Featherstone et al., 2011).

Another way that status issues can be addressed in the moment is by assigning competence. Assigning competence involves noticing intellectual contributions made by students who have been labeled as low-status and bringing these publicly to the attention of the class or group (Featherstone et al., 2011; Hand, Kirtley, & Matassa, 2015). When addressed publically, and specifically relevant to the group task, assigning competence can change the classmates' perceptions of peers, as well as students' self perceptions (Cohen, 1994). Through the noticing of resources and potential, as opposed to focusing on deficits, teachers not only begin to think and speak differently about their students, but it can assist students in noticing mathematical strengths in themselves and their peers (Jilk & Crespo, 2015). When students see their group members have a variety of skills and insights to offer that might not fit within the former definition of being smart in math, this helps dispel the overall belief of certain people being "math people."

In order to address status problems, Complex Instruction offers a number of tools and strategies. Three main components are norms, roles, and task design. In the sections below, I will reference the literature to describe each of these components and how they relate to status.

Norms

Another component of CI are the specific behaviors required for doing mathematics in a group; what it looks like, sounds like, and what the expectations are of each of the members

(Cohen, 1994; Featherstone et al;, 2011). Norms help to redefine what mathematics is and what it means to do mathematics by promoting student autonomy and group interdependence (Featherstone et al., 2011). Some examples of CI norms include but are not limited to, everyone contributes, no one person dominates, you have the right to ask questions, helping is not telling, and I can't…yet (Cohen, 1994; Featherstone et al., 2011; Horn, 2012).

Norms seem simple enough, and are often visibly present in classrooms, regardless of any connection to CI. However CI norms are more than a classroom management tool. Not only do they help advance students' learning, but CI norms also help suppress status issues that can interfere with learning (Horn, 2012). It is essential to the success of enacting norms to keep the connection between norms and status forefront in one's understanding. Additionally, expectations and subsequent follow-through on norms is crucial for them to become enmeshed in the fabric of the classroom. When classroom routines and activities contradict CI norms, students and teachers alike tend to revert back to familiar behaviors, causing established issues of underparticipation and status to increase (Horn, 2012). To stave off any slipping of abiding by the norms, it is important the ways of doing and talking about mathematics in groups is established early, and reinforced often. This helps students reframe their understanding of how to do school, which has often times been ingrained and reinforced since the start of their educational careers (Featherstone et al., 2011).

Once the school year is underway, participation quizzes can be a tool to practice established classroom norms and reinforce expectations (Featherstone et al., 2011; Watanabe & Evans, 2015). Participation quizzes can be used to reset a norm, should it have fallen by the wayside, or it can be a means to highlight a norm the teacher feels would be particularly helpful, given current classroom dynamics. To this end, participation quizzes should be used to highlight

positive norms or note a positive change, as opposed to being used punitively (Watanabe & Evans, 2015). For a participation quiz, the teacher takes notes on students' collaborative actions, student discourse, and intellectual contributions (Featherstone et al., 2011; Watanabe & Evans, 2015). These notes are posted publically for the students to see as they work, and then are discussed as a collective group. Participation quizzes, due to their public nature is a way to highlight valued actions and encourage productive behaviors (Featherstone et al., 2011). They provide students feedback as well as models of desired behaviors.

Roles

Another component of CI is the establishment of student roles. The roles distribute the duties and responsibilities of engaging with and completing a mathematical task, in an effort to promote equity of participation among the group members (Cohen et al., 1994; Featherstone et al., 2011). As with norms, the assignment of roles is not something that is specific to CI, however the purpose of CI roles is unique. The roles aid in structuring the work so that each student can contribute in intellectually significant ways, thereby working towards equalizing issues of status that hinder the learning of all students (Featherstone et al., 2011). More than a classroom management strategy, roles exist to quash status issues.

To that end, as long as roles are in service to addressing status and increasing participation, there is flexibility. While there are the standard roles such as facilitator, resource monitor, recorder/reporter, and questioner, they are not set in stone. Roles can be modified for the purpose of encouraging particular student behaviors. Ehrlich (1991) modified the role of reporter, to include the completion of a reporter form in an effort to organize the group's thoughts and increase student interaction. Reporters completed the form in collaboration with their

groupmates which resulted in a demonstration of improved communication skills (both written and verbal), increased reasoning abilities, and more precise use of scientific vocabulary.

As an example of the flexibility with roles, nearly 30 years later, a group of elementary teachers struggled with implementation of the roles. They were not experiencing a positive impact on student participation and they struggled to see how roles were helping to address issues of status. These teachers decided the role of Recorder/Reporter could be replaced by a new role called Turn Tracker (Hackett, Wood, Wheeler, & Valentine, 2019). While performing similar duties to the previous role, the new version specifically called out the use of a turn taking protocol when student groups seemed to experience issues with ensuring everyone's voice was heard.

While all roles are important to the functioning of the group, and need to be structured as such in their service to equalizing status, Zack (1988) looked specifically at the role of facilitator to examine if increased use of the role had impact on student discussion and cooperation. Zack hypothesized that as teacher facilitation decreased, reliance on the student facilitator would increase thereby positively affecting group conversation. Through this study, Zack concluded that groups experienced increased interdependence and effective conversations as the role of facilitator was enforced (1988).

Through the implementation of roles, regardless of what they look like, the teacher is freed from the more traditional function of direct supervisor, to one of a resource of information (Ehrlich & Zack, 1997). Through the use of group roles and norms, CI encourages participation from all members, so that the resulting product is a reflection of all of the students' combined efforts, rather than attributable to any one student (Cohen et al., 2002).

Multiple-Ability Tasks

As students are encouraged to engage in the norms and roles of CI, we must ensure the tasks are presented to them are ones that are deserving of being called groupworthy. Groupworthy tasks are those suited and designed for collaborative learning; the tasks should be too complex to be completed individually (Featherstone et al., 2011; Horn, 2012). Lotan (2003) outlines six common features that groupworthy tasks have: they focus on central ideas, they require some interpretation, they provide multiple ways to demonstrate competence, they promote student interdependence, they provide opportunities for group and individual accountability, and they include clear evaluation criteria. While all features are important to the development of a groupworthy task, the idea of multiple ways to develop competence connects to the idea of redefining smartness, and reinforces the idea of group interdependence.

When students work together on a multiple-abilities task, that task should allow students to use a wide range of intellectual abilities, showcasing more than one strategy in which to achieve the correct answer. This allows students to contribute their unique skills and behaviors to the task, while also being interesting, challenging and rewarding tasks in which the students engage (Cohen, 1994). "No one student has all the abilities necessary to complete the task successfully, but that a group of students, together, will have the skills they need to succeed" (Featherstone et al., 2011, p. 69). The tasks students engage in during CI foster the motivation necessary for productive mathematical communication among group members (Sfard & Kieran, 2009), as students' reliance on their group mates in a multiple-abilities task increases the need for communicating among the members.

A challenging task that generally has more than one answer or more than one way to solve the problem allows learning to occur along a broad range of intellectual abilities. Tasks of this nature allow different students to make different contributions by requiring a variety of skills

and behaviors (Cohen, 1994). “The given task challenges their individual math smarts and suggests to them that, by working with others, they will have a better chance not only of conquering the challenge but also of learning more” (Featherstone et al., 2011, p. 59).

An "Idealized" Version of CI

There is not an idealized version of CI in the education research literature. "Complex Instruction is not a magic pill. It contains no formula or checklist to follow. Complex Instruction is, in fact, complex. Its components intertwine, and there is always too much to attend to" (Featherstone et al., 2011, p. xii). Despite these words from Lisa Jilk, there are particular components and tenets that separate CI from more mainstream, cooperative learning models. Perhaps the most unique feature of CI is the attention to how status differentials can positively or negatively impact students' learning. Through the enactment of CI lies an opportunity to address status issues among the students that result in unequal participation in learning. CI opens up opportunities to challenge particular mindsets related to academic abilities, which can open up space for students to contribute to group discussions around a successful group product that highlights the students' learning.

However, the opportunity for group interaction only offers the chance for this to happen. In order to address status, teachers have to do more than put students in groups. "They [teachers] have to develop a set of principles, structures, and strategies for interacting with students around mathematics. In this way, students have opportunities to engage their own ideas in various ways" (Horn, 2012, p. 3). To this end, there are particular structures and strategies (i.e. norms, roles, and tasks) that are commonly referenced in the education research literature that allow teachers and students to disrupt issues of status. Through the mindful use of norms, roles, and multiple-

abilities tasks, teachers can develop a learning environment where students feel productive, valued, and smart (Cohen, 1994; Featherstone et al., 2011; Horn, 2012).

While I am not outlining exactly what these enacted structures might look like, the components of student roles, classroom norms, and the engagement with multiple-ability tasks are important tools for equalizing issues of status that might interfere with students' learning. When the three components work in conjunction and can be seen to have a positive effect on students' status, I am defining that as an idealized enactment of Complex Instruction. To be clear, I am not arguing that these are the only critical components of CI or that the only successful enactment of CI has these three components. Instead, when teachers are taking up CI and using these three pieces, they have the opportunity to effectively address status. Figure 2.1 shows not only the interrelatedness of the three components of CI that are most prevalent in the literature, but to also shows student status as the underlying tenet which makes Complex Instruction more than students placed together in a group.

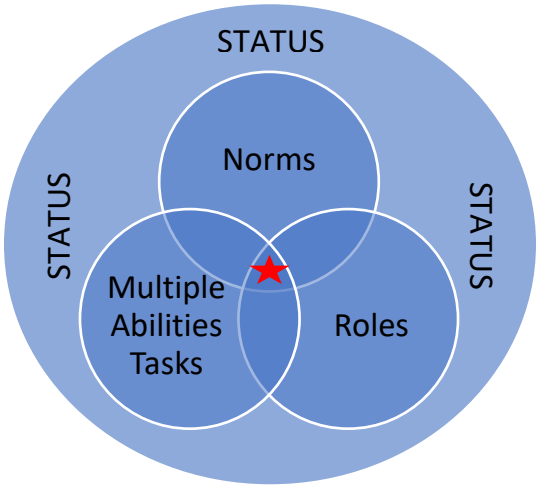


Figure 2.1. An idealized version of Complex Instruction (modified from a figure by Lisa Jilk, personal communication, 2017)

The Case of Railside School

Perhaps the most famous, or at least the best documented, case of implementation of CI is the case of Railside School (e.g. Boaler, 2006; Boaler & Staples, 2008; Boaler & Staples, 2014; Horn, 2008; Wright, 2012). While much of the research literature on CI hones in on particular components, or references CI in general as an example of best practices for equitable mathematics instruction, the published works on the case of Railside School are the most comprehensive view we have of complete enactment.

Railside was an urban school with a diverse population of traditionally marginalized students who had not historically experienced much mathematical success. However, due to the systems put in place by Railside's mathematics department, students exited their high school career having achieved higher levels of proficiency, had been enrolled in more advanced mathematics courses, and self-reported greater satisfaction with mathematics, as compared to students at other schools. The success the students experienced can be attributed, but not limited to several factors. First, all students had equal access to conceptual-based reform-oriented curricula. The teachers in the mathematics department had worked for over a decade in developing a curricula that was groupworthy, meaning it allowed for multiple points of entry and attended to various levels of cognitive demand. Secondly, all students had access to the equity-minded instructional practices that are the basis of CI. These practices included questioning techniques, the establishment of social and sociomathematical norms, the use of student roles as an avenue to increase student responsibility, and the addressing of status issues through assigning competence (Boaler & Staples, 2014).

Railside School provides a glimpse into what is possible when the “sweet spot” of CI is realized. While any one component can promote partial equity and access to the mathematical

learning in a classroom, all components, working in conjunction to positively impact student status, and therefore access to learning, is the quest of CI implementers.

Complex Instruction as the Instructional Practice of Focus

In chapter 1, I described a prior experience with teachers and their implementation of CI in their classrooms. Going though each of the sections of the literature presented, I struggled pinpointing exactly why the level of enactment was not where anticipated.

In terms of PD, while I do not claim perfection, many of the big rocks that tend to interfere with teacher implementation of a new practice were removed. The experience spanned an entire calendar year, with multiple cycles of hands-on workshops, implementation in their classroom settings, and check-ins for reflection and collaboration. The *what* of CI enactment was always dove-tailed with the *why*, through the constant conversation regarding student status, access to mathematics, and reinforcement of the idea that we are smarter together.

Gathered from whole group and individual conversations, as well as from written reflections, the experiences the teachers had throughout the year seemed to be addressing beliefs and learning goals. There did not seem to be any misalignment between what the teachers said they believed about mathematics teaching and learning or their students that would conflict with the instructional practices of CI. And given the overwhelming success of the enactment of CI reported by Railside, I was stumped as to what went wrong.

Practicality Theory

CI, regardless of success exhibited at Railside School and other isolated cases, will do little to positively impact status effects on student learning if it is never implemented. And yet, there are far more documented proposals and intentions around CI as opposed to actual documented implementations of the instructional practice. This phenomena of anticipation

versus enactment is not unique to CI. The list of what and how to change instruction is exhaustive in the mathematics education research literature, including topics such as orchestrating productive mathematical discussions, facilitating number talks, and implementing standards through mathematical problem solving, to name a few (Foote, Earnest, & Mukhopadhyay, 2014; Parrish, 2010; Stein & Smith, 2011). And yet, very little change occurs to most teachers instructional practices (Hiebert et al., 2005).

One theory that seems particularly helpful in understanding how and why teachers might or might not change their teaching practices is Practicality Theory (Doyle & Ponder, 1977; Janssen et al., 2013). Practicality theory is an attempt to analyze a teacher's implementation of new innovations within their existing instructional environment. Through practicality theory, the rhetoric shifts from what should occur in a classroom to how a teacher responds as they go about enacting the instructional practice in their established environment (Doyle & Ponder, 1977). “Statements of how change should occur are not very useful in interpreting how classroom teachers actually respond to influences which impinge upon their established habits and practices” (Ponder & Doyle, 1977, p. 2). The decision-making processes that impact the degree to which a teacher takes on new practices is brought to the forefront when looking through the lens of practicality theory. The more practical the practices in the mind of the teacher, the more likely they will make their way into the classroom environment.

Ponder and Doyle define the term practical as "an expression of teacher perceptions of the potential consequences of attempting to implement a change proposal in the classroom” (1977, p. 14). Simply put, instructional practices that are deemed practical have positive consequences to their classroom environment and therefore will be attempted. Impracticality, based on negative consequences brought on by such changes, is rejected. Brophy and Good

argued that these judgments of practicality are often made quickly, with little experience or evidence (as cited in Ponder & Doyle, 1977), and are not isolated to one's initial attempt at implementation. As certain components of a new innovation are tried and evaluated a teacher makes judgments based on the success or failure in regards to their learning goals and desired outcomes. In response to not attaining the desired results from enacting a new instructional practice, teachers will most often revert back to what they know, despite the fact that those practices are as unproductive in helping them achieve their goals as they were initially (Guskey, 1986). “The ultimate fate of an innovation would seem to depend upon user decisions” (Ponder & Doyle, 1977, p. 6).

Practicality theory outlines three dimensions by which teachers analyze suggested innovations to determine its practicality and if they will adopt it in their teaching repertoire. Per this theory, teachers consider a suggested innovation based on its instrumentality, congruence, and cost, in relation to their current instructional practices (Janssen et al., 2013). Teachers might not consciously classify their considerations into these categories, but many common reasons why or why not to innovate can be categorized into one of these three dimensions.

Instrumentality

An innovation's instrumentality refers to the specifications of enactment; a step-by-step process of how the innovation takes place within the existing classroom ecology (Doyle & Ponder, 1977). It is converting an innovation from its intended principles to its specific "time and cost efficient" procedures (Janssen, Westbroek, & Doyle, 2014, p. 197); moving it from the abstract theory to the concrete actions. For a teacher to consider use of the innovation within their own classroom context, the innovation's procedures need to have some alignment with the existing classroom structure. Taking into account the social, behavioral, and conceptual

environments of the individual classroom (Janssen et al., 2013), an innovation will most likely not be enacted if the teacher cannot envision the procedures within the constraints of their teaching context. For clarity of vision, the procedures should be outlined clearly and succinctly, and teachers generally find it helpful to learn about and experience the innovation in an actual classroom setting (Ponder & Doyle, 1977). “Communicating the innovation in procedural, ecologically relevant terminology is a necessary condition for eliciting initial teacher evaluation of the practical merit of the change proposal” (Ponder & Doyle, 1977, p. 18). Essentially a teacher needs to understand the ins and outs, the whats and the hows, of the innovation. They need to be able to clearly visualize what the enactment looks like in their classroom, complete with any preparation required and elements in the moment.

Congruence

The congruence dimension of practicality theory has several aspects by which teachers might judge the practicality of a given innovation. To start, congruence of an innovation refers to the alignment with the teacher's current instructional practices, goals and values, and identity (Doyle & Ponder, 1977; Janssen et al., 2013). To analyze a practice along the congruence dimension, a teacher might consider if the intended principles of the innovation align or not with their current beliefs, goals and values “Does the change fit the teacher’s situation and contribute to or undermine the goals he or she wants to realize” (Janssen, Westbroek, & Doyle, 2014, p. 197). The more an innovation contributes to current teaching and learning goals, as well as the degree to which the innovation aligns with the teacher's values and beliefs, the higher the probability that a teaching practice will be incorporated into the instructional routine. Teachers will also take into account the students' values and beliefs when considering a new practice. There needs to be a compatibility between the proposed innovation and what is considered

business as usual in the classroom. If the teacher anticipates an adverse reaction from the students, they are less likely to enact the innovation (Ponder & Doyle, 1977).

Additionally, there is an evaluation of the congruence of the innovation's credentials. Teachers want to know the previous data and success of the innovation, as well as the source of its origins (Ponder & Doyle, 1977). Something that has been long-tested and proven effective, with a population of students similar to the teacher's own, will have a better chance of being integrated into current practices.

And finally, related to the instructional context, is the alignment between the suggested innovation and the existing demands in the teaching environment. Schools tend to be hot-beds for sweeping initiatives and at times, these programs and practices can run counter to each other. If a proposed innovation is going to conflict with elements of pre-existing mandates, a teacher is less likely to work to incorporate something else into their classroom.

Cost

The third dimension of practicality theory is one of cost. A teacher will evaluate an innovation based on its cost; they will question to what degree the innovation requires the establishment of new behavior patterns which is based on its complexity. They will weigh the effort and required resources to enact the innovation, which include time as well as materials, against the expected return in everyday teaching demands and positive impact on student outcomes (Ponder & Doyle, 1977). “Is the change justified within the limited time, knowledge, and resources at his or her disposal” (Janssen, Westbroek, & Doyle, 2014). The ease of implementation, along with ideas of personal effort, is compared to any potential returns.

There is also a social element to the dimension of cost, and a comparison of social costs to social rewards. Social costs might be reactions by students, colleagues, and administrators, to

the teacher's enactment of a new instructional practice. A teacher might analyze how incorporating a new practice might affect their status and social position within their classroom, grade level team, or school building. The greater the perceived risk of opportunity for opposition and consequences to one's reputation or position, the less likely the innovation is to be enacted (Becker, 1970).

Interactions Among the Dimensions

As an analysis tool, practicality theory is helpful to better understand what teachers might consider as they decide whether or not to take up particular innovations. However, the classification of these considerations into the three dimensions might not be quite as compartmentalized as they first seem. In their description of the instrumentality dimension, Janssen, Westbroek, and Doyle (2014) refer to an innovation’s procedures being efficient in the realm of expended time and cost, demonstrating some overlap between the dimension of instrumentality and cost. Additionally, there is some interplay between the congruence dimension and the cost dimension. For example, in the congruence dimension, a teacher will consider students' values and beliefs when considering a new practice and if there is an anticipated adverse reaction the teacher is less likely to enact the innovation (Ponder & Doyle, 1977). However, this decision could also be seen through the cost dimension, as an evaluation of the social costs of enacting an innovation. The muddling continues: In a description of the congruence dimension, there is a reference to "normal procedures and activities" (Janssen et al., 2013, p. 4), which seems to be a description that infringes on the instrumentality dimension. So, while practicality theory does have three dimensions, they are not strictly compartmentalized and there might be some overlap when it comes to classifying the reasons why teachers might chose to enact or not particular innovations. The following outlines a methodology by which the

enactment could be broken down in an effort to better identify where implementation was falling short as well as what steps were being made to meet expectations.

Heuristic Goal System and Teacher Impact Analysis as a Bridging Methodology

The heuristic goal system (HGS) map is a way to elicit a teacher's anticipated instructional practices to identify entry points for a suggested innovation (Janssen et al., 2013; Janssen, Westbroek, & Doyle, 2014). Through construction of a HGS map, a teacher's anticipated lesson is sequenced out. The lesson segments, or the *what*, describe the sequence of events that will occur during a lesson that are either student or teacher directed. The teacher is then invited to reflect on the *why* behind each of the lesson segments. In other words, to describe what the learning goals are that drive each of the actions in the lesson segments. Often times, there are multiple goals, or a hierarchy of goals that are revealed through this practice. Each of the lesson segments, or the whats, are connected to the learning goals, or the whys, that they serve. Finally, the teacher describes *how* they will prepare for the anticipated lesson, and they connect these hows to the corresponding whats. At this point, the HGS map is complete, and the Teacher Impact Analysis (TIA) can begin.

For the TIA, the teacher is asked to evaluate their whats and their whys of their planned instructional sequence (Janssen et al., 2013; Janssen et al., 2014). They are asked to identify learning goals they feel are not currently being met to the desired level. These goals are traced back to the related lesson segments that are currently planned. At this point, the teacher can combine, adapt, or replace a segment of what was originally planned with the suggested innovation, in an effort to better meet the stated goals. It is at this point a component of the suggested innovation can replace the ineffective lesson segment of the planned instructional sequence. If there are components of the suggested innovation that might better allow the teacher

to achieve their desired learning goals, the component of that new instructional practice replaces the original anticipated lesson segment, thereby bridging the gap between the teacher's current instructional practice and a more idealized version of the suggested innovation. Over a period of time, it is possible to design a flow of instruction that gradually adapts one's teaching practice towards an idealized version of the suggested innovation, in a way that the teacher considers is an improvement and helps them better achieve their instructional goals.

In the existing literature on practicality theory, the use of the HGS and the TIA are presented as co-constructed processing and analysis tools (Janssen et al., 2013; Janssen et al., 2014). While the teacher creates the HGS based on their planned instruction, and the teacher evaluates which of their instructional goals are not currently being met by the planned lesson segments, a researcher or instructional coach might offer guidance in regards to how the suggested innovation might be adapted into the teachers' lesson segments. Based on the information gathered from the HGS and the TIA, a professional development trajectory might be designed, where a teacher gradually incorporates specific components of the suggested innovation, until an idealized enactment (or as close as they might get) of the suggested innovation is achieved, and the teacher feels that they are meeting their stated instructional goals. This process of bridging the current practice to an idealized version of enactment is heavily influenced by the outside party. However, it might be possible for a teacher to engage in the bridging process without as much guidance from an outside facilitator. A teacher who is familiar with a suggested innovation, and who has implemented various components of the innovation into their instructional practice in the past might identify for themselves how they see the suggested innovation currently aiding them in achieving their instructional goals. When a teacher identifies for themselves where and how they want to integrate the suggested innovation into

their current instructional practice in an effort to achieve their instructional goals, I am calling that "self-bridging".

The process of bridging or self-bridging from current practice to an idealized enactment can address (in part) some issues a teacher might be having with the instrumentality, congruence or cost of an innovation. Because the innovation is being introduced to the classroom context in lesson segments as opposed to be enacted full out, it might make it easier for a teacher to envision the specific procedures of the innovation and develop a closer alignment with the innovation and the existing classroom procedures, thereby mitigating some issues related to instrumentality. Since the purpose of introducing the innovation is in an effort to assist the teacher in achieving their instructional goals, some aspects of a misalignment along the congruence dimension regarding enacting the innovation might be lessened. If the cost of enacting the innovation compared to the benefits is perceived to be too high, this might be addressed to some degree due to a lessened expenditure of effort by only enacting a component of the innovation as opposed to going all in. The adjustments made to the HSG through the TIA represent the teacher's practical model of incorporating the new practice. Furthermore, it launches the momentum for the bridging between the teacher's current instructional practices as they move towards a more ideal enactment of the suggested innovation (Janssen et al., 2013; Janssen et al., 2014).

Practicality theory can be helpful when analyzing why teachers might or might not alter their instructional practices. Arguably, the dimensions of practicality theory do not stand in isolation but are interwoven and influenced by teachers' beliefs and their learning goals. The act of teaching is not linearly sequenced or transparent. Teachers may not even be aware of beliefs they hold about teaching and learning or beliefs about their students. Teachers also might not be

attuned to how those beliefs impact practice or misalign with their instructional practices. Teachers might have several learning goals and may not realize they are competing. Further research on how and why teachers choose to enact an innovation, in this case CI, is needed, with the aim of understanding how beliefs and goals interact with instructional practices.

Purpose of the Study

The purpose of this case study was to explore teachers' enactment of the instructional practice of CI. During a series of interviews conducted before and after teaching mathematics lessons, teachers reflected on their practice, their learning goals, and their beliefs about teaching and learning mathematics and their students. The dimensions of practicality theory were used as a tool to analyze the alignment between these constructs. Throughout the process, the HSG and TIA help to highlight the instructional decisions the teachers made in an effort to realize a more ideal enactment of CI. This study will serve the purpose of documenting what might be some roadblocks as teachers enact CI, so that we might better address those road block from the start.

Research Questions

The question of investigation is as follows

Using the lens of Practicality Theory, what factors do teachers consider as they contemplate enacting Complex Instruction? There are two subquestions:

1) What connections do teachers articulate among their beliefs, their goals and the practice of Complex Instruction?
2) What factors support and what factors interfere with teachers' alignment of their enactment of Complex Instruction with their goals and beliefs (including factors that might improve alignment and those that might maintain alignment)?

CHAPTER 3
METHODS

The goal of this case study was to explore teachers' instructional practices as well as the process by which these practices underwent any transformations to better meet stated learning goals and more closely align practices with their beliefs about teaching. In this qualitative study, I used case studies and practicality theory to consider how teachers potentially shift toward more innovative teaching practices. The analysis involved multiple steps. I used a case study methodology to explore the connections teachers made between their beliefs about teaching and learning mathematics and their learning goals, to their anticipated instructional practices around Complex Instruction (CI) in the classroom. I then contrasted their anticipated practices to their enacted practices. As teachers worked to incorporate CI into their classrooms, I used practicality theory (Doyle & Ponder, 1977) to understand the decision-making processes the teachers underwent regarding adaptation. In this chapter I present: the research context, my positionality, a definition of case study methods, the data sources, and descriptions of data analysis.

Context

Positionality

I was an employee of Marathon School District. This was the same school district in which I started my career as a classroom teacher, and then moved into the role of instructional coach for one school site, before moving into administration at the district level. I worked with teachers of kindergarten through high school in 21 schools. My interactions with teachers varied from one-on-one coaching and observations of classroom instruction to the facilitation of PD focused on pedagogical and/or mathematical content knowledge. My “insider status” of doing research within my place of employment was a benefit, in that I already had a rapport established

with my research participants, as well as had an understanding of their teaching context (Weis & Fine, 2000).

However, my “insider status” was also a hindrance because of my leadership position within the district. While I did not conduct the teachers' evaluations, the teachers were used to asking me for information and advice about their mathematics instruction. While collecting data for this study, the teachers would sometimes ask me what I thought they should do. I tried to refrain from providing any type of guidance or suggestions. I failed on this point in several cases (which I describe in the findings), despite the best of intentions.

Adding to the teachers' direct inquiries as a type of intervention, my mere presence in their classrooms was an intervention of sorts, in the fact that the teachers knew my focus was on their enactment of CI. To this end, the teachers may have engaged in the practice in ways and to a degree that they otherwise might not have had I not been present. Through the interviews, the lesson observation cycles, and the HGS mapping, the teachers were hyper-aware of the CI focus, and that may have skewed their responses.

Research Setting

Marathon School District (all names are pseudonyms) was located on the south side of a metropolitan city in the southwestern region of the United States. In 2016/2017, the school district serviced about 16,000 students. Of that population, 93% qualified for free/reduced lunch and 18% were considered English Language Learners (ELLs), speaking primarily Spanish outside of school. Scores on the state standardized mathematics assessment for the 2016/2017 school year were low in comparison to the state average, but showed an increase over the last few years. Based on cutoff scores, 26% of Marathon's students were deemed mathematically proficient in comparison to 39% of students scoring proficient statewide. The average time

devoted to core mathematics instruction across the school district was anywhere from 60 to 120 minutes per day. Class sizes ranged from 20 to 35 students depending on the grade level and current enrollment numbers.

The school district's foundational curriculum resource for kindergarten through fifth teachers was a collection of open educational resources (OER). With the adoption of the *Common Core State Standards* (CCSS) in 2010, the district's Curriculum and Instruction Department decided to have curriculum writing teams compile OERs in lieu of purchasing curricular materials that aligned with the new standards. The writing teams comprised of several teachers per grade level from various school sites within the district. They met for several weeks in the summer, as well as periodically throughout the school year, to compile, revise, and update the materials, based on feedback from their colleagues. To supplement the OER units, teachers in grades third through fifth had access to a digital mathematics curriculum that was developed a couple of years after the release of the CCSS.

Teachers of grades sixth through eighth were in their second implementation year of a newly released on-line problem-based curriculum. This curriculum was freely available under the Creative Commons OER license and claimed to have full alignment to the CCSS.

For all grades, teachers were strongly encouraged to use the materials that were provided. However, they were given the freedom to adjust as necessary, based on the needs of their students. The district provided pacing calendars, standards alignments, and common end of unit assessments. For third through eighth grades there were also quarterly interim assessments based on the standards used as proficiency predictors for the annual state standardized assessment administered each spring. A teacher might veer from the available resources, but they were bound by the district-provided scope and sequence.

Participant Selection

Since I was interested in CI as an innovation, I sought out teachers who had prior exposure to and experience with the instructional practice of CI. The pool of potential participants for this study, who had prior knowledge of CI, consisted of 35 teachers, grades kindergarten through sixth. These teachers were invited to sign up for an advanced workshop focused on CI, as fulfillment of their monthly professional development (PD) obligation required by the school district. Of those eligible, ten teachers signed up for the workshop. Prior to the start of the monthly sessions, I extended an email invitation to the ten teachers to participate in this research study. I hoped to have four participants, but only three volunteered. I was cautious not to badger the teachers to sign up, given my positionality within the research setting, as well as being cognizant that the teachers would be volunteering a considerable amount of time to the study, as there was no financial compensation provided.

Focal Participants

Meg. Teaching was Meg's second-career, as she had retired from being a speech pathologist serving the public school system. Her seven years as an educator was as a 5th grade teacher. Meg was referred to by some as a "rock star" teacher who was constantly looking for learning opportunities to refine her craft. She frequently attended PD experiences, and incorporated the new learning in her classroom. When Meg reflected on her instruction, she usually veered towards being self-critical, but used her evaluations to make modifications to better meet the needs of her students.

Several years ago, Meg participated in a year-long PD experience focused on Complex Instruction (CI). During the spring semester, she engaged in a book study where she learned about and explored the components of CI. In the fall, with a new class cohort, Meg was

encouraged by the PD's facilitator to implement CI full scale. Over the years, Meg also attended mini-workshops on CI, as well as collaborated with her school's instructional mathematics coach, who was familiar with the instructional practice. Meg was considered well-versed on the concept, which made her an excellent candidate for study.

Lee. Lee was a teacher of primary-aged students with 20 years under her belt. Her prior experience included 7 years teaching kindergarten, 3 years teaching 2nd grade, and 10 years teaching 3rd grade. Lee was a National Board Certified teacher, and held endorsements for Structured English Immersion (SEI) and Gifted education. Lee's 3rd grade students were identified as gifted on the CogAT test, scoring in the 9th stanine, and were clustered as a cohort since 2nd grade. Lee's affinity for mathematics and science education came across quite blatantly in conversation and was reinforced by the PD and educational experiences in which she engaged.

In the Spring of 2016, Lee participated in a semester-long book study focused on Complex Instruction. Throughout the PD, Lee was asked to read chapters of *Smarter Together*, and informally implement various components in her classroom. While Lee was intrigued by the idea of Complex Instruction, and was drawn to similar PD experiences over the years, the instructional practice was not something that took off in her classroom in any formal way. However, due to Lee's familiarity with the concept and willingness to study it further, in addition to her reflective nature, she made an excellent candidate for this study.

Kay. Kay was a 6th grade teacher who spent 13 non-consecutive years in elementary education trying to find her niche; she bounced from grade to grade, and school to school, and even served a year's stint as the behavioral specialist for elementary students. She began her career in 2nd grade and 4 years later took on a 4th/5th English Language Learner (ELL) class for one academic year. She spent 2 years in 4th grade, 3 years in 5th grade, and 2 years as a 6th

grade math teacher. At the time of her participation in this study, Kay was contemplating moving to 3rd grade the following school year, because she felt she'd been in one place for too long. Somewhere along the line, Kay had left teaching for a year or two, to return to her previous employer. While the daily hours and holiday breaks of teaching appealed to Kay, the pay provided by her previous employer was competitive. Back in the education world, Kay recently earned her Master's degree in Administration and had her eye on being a school principal. This was a driving force in the contemplation of changing grade levels. She thought having classroom experience in as many grades as possible would strengthen her skills as an instructional leader.

In 2014, Kay took advantage of a PD experience focused on Complex Instruction that spanned a calendar year. During this time, she engaged in a book study where she learned about and explored the components of Complex Instruction. In the fall, with a new class cohort, Kay was encouraged by the PD facilitator to implement CI full scale. Over the years, Kay worked with an instructional mathematics coach at her school site who was familiar with Complex Instruction. Because of Kay's familiarity with CI, she was a great candidate of focus.

Definition of Qualitative, Case Study Method

Since I sought to explain the *how* and the *why* teachers chose to modify their instructional practices, with an in-depth, extensive description and exploration, a case study methodology was most relevant (Yin, 2014). A case study was most applicable given the complexity of teaching processes and the relationship of said processes within given contexts. Any changes that occurred within these process needed to be traced over time. The purpose of this study was to describe several individual cases of elementary mathematics teachers incorporating the pedagogies of CI into their current instructional practices. This process of description and

exploration allowed me to use several data collection methods and analysis tools (Yin, 2014) in an effort to paint a more complete picture and triangulate the collected data.

Overview of Qualitative Data Collection

I collected five types of data: a demographics survey, audio-recordings of interviews with the teachers, video-recordings of observed classroom lessons, written reflections from the teachers after their enacted lessons, and miscellaneous artifacts from the lesson enactments.

Demographics Survey

The demographic information survey was included in the invitation email to participate in the study and sent to the ten teachers who had signed up for the advanced CI workshop. The completion of the survey was my notification that the teacher had self-selected to participate. In the survey, the teachers provided information regarding their certifications and endorsements, the number of years they had been teaching, and the grade levels they had taught.

Initial Project Interview

Each of the three teachers was individually interviewed prior to the start of the spring semester (see Appendix A). The focus of the semi-structured interview was to explore their beliefs about teaching and learning mathematics, as well as to gather general data regarding their typical mathematics lesson structure. The semi-structured interview consisted of questions about the teachers' beliefs, instructional practice, and the teachers' perceptions of existing relationships between, and influences on, their beliefs and practices (Raymond, 1997). I also asked teachers to provide a definition of Complex Instruction, as well as inquired as to whether they believed there were status issues among the students in their class. The semi-structured nature of the interview allowed me the freedom to probe a response further for clarification or ask additional questions based on a teacher's response. The interviews lasted about 60 minutes and were audio-recorded.

Lesson Observation Cycles

The three participant teachers underwent three lesson observation cycles throughout the semester. A lesson observation cycle included a pre-interview, where the teacher outlined the lesson I was going to observe. Then, the teacher and I co-constructed the Heuristic Goals System (HGS) map, where the teacher identified their main learning goals and we discussed how the components and tenets of CI might assist them in attaining their goals. See Figure 3.1 for an example of an HGS. I observed the lesson, and immediately after the lesson, the teachers filled out a written reflection form, where they responded to a few questions while the lesson was fresh in their mind. Ideally, within a day or two, the teacher and I would meet for a post-interview, where the teacher reflected on the lesson, how they felt it went in terms of their identified goals, and how the components and tenets of CI aided, or didn't, in the attainment of their goals.

I wanted the lesson cycles to occur in January, March, and May, so as to capture changes over time in terms of the teachers' instructional practices and implementation of CI. For Kay, the timeline ended up quite muddled. She became ill and due to scheduling conflicts, we were unable to have our first lesson cycle until the end of February. She became ill again, the school district closed for Spring Break, and when classes resumed, it was time to administer the annual state assessments. On top of all this, due to political turmoil, the school district closed for a week. Kay and I were able to complete three lesson observation cycles, but the second and third cycles happened both in May, and were only a week apart.

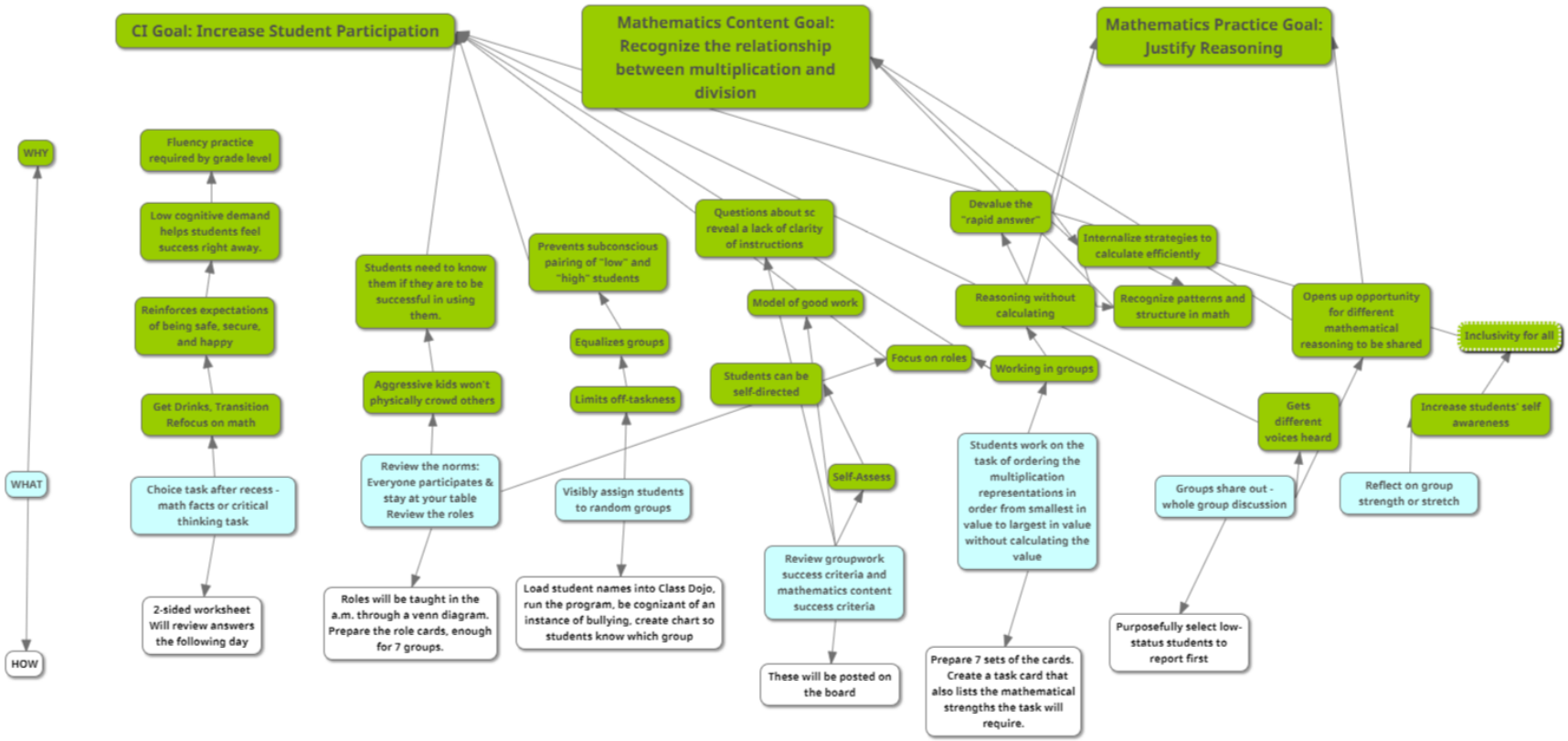


Figure 3.1. Heuristic Goal System (HGS) Map
Lee's anticipated instructional practice for the first lesson observation.

Pre-Interview for lesson observation. At the start of each lesson observation cycle, the teacher and I engaged in a pre-interview (see Appendix B). During this time, the teacher outlined the segments of their lesson I would come observe, which was typically within the next day or two. During the pre-interview, I asked the teacher *what* they and the students would do during the observed lesson, *why* these tasks were important to do in this way, and *how* the teacher would prepare for and enact the lesson they described. As the teacher was talking, I scribed their various *whats*, *whys*, and *hows* on notebook paper or on individual post-its.

Next, the teacher drew arrows to connect the various tasks (*what)* that they and the students would do during the observed lesson to the various goals *(why)* they had identified that they had for their students' learning. The teachers were instructed that several tasks could serve the purpose of a singular goal, or that multiple goals might connect to a singular task. They were also asked to not force any connections; so at the end of the exercise, if there was a task that had no attached goals, or a goal with no attached task, that was okay. See figure 3.2 for an example of Meg's HGS map for the third lesson observation cycle.

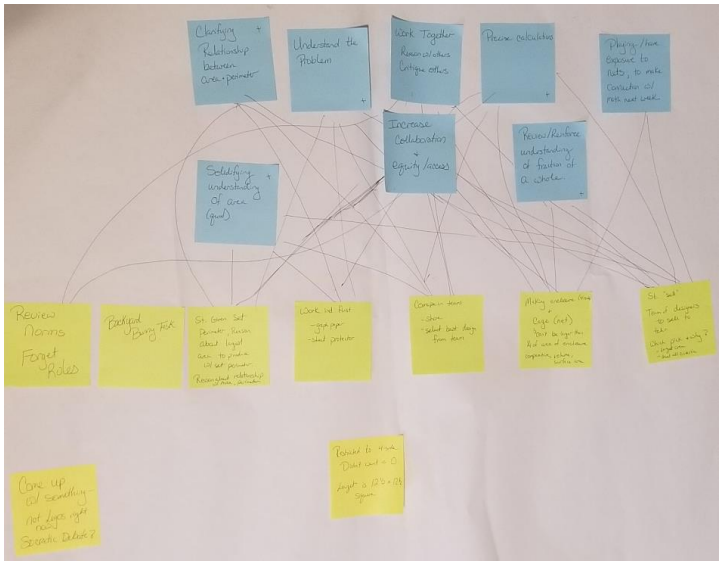


Figure 3.2. Heuristic Goal System (HGS) Map
Meg's anticipated instructional practice for the third lesson observation.

After the teachers had made the connections between their tasks and goals, they were asked to identify which goals they were currently meeting to their satisfaction. They indicated these goals with a plus sign. The teachers were also asked to identify which learning goals they felt were not currently being met and were something that they struggled with. They indicated these goals with a minus sign. The goals that the teachers identified as struggles became the learning goals for the observed lesson. All three teachers identified several goals that they wanted to focus on during their lesson observations, and I noticed that the goals could be categorized as a mathematical content goal, a mathematical practice goal, and a groupwork goal, so that became the way we referred to them. The categorization of the goals was not a part of practicality theory, but rather something I noticed and a way I made sense of the teachers' multiple goals.

Once the teachers identified their learning goals, I inquired as to how they saw the components and tenets of CI assisting them in attaining their learning goals. Specifically, we looked for places within their planned lesson segments that CI was already in play. If they had not anticipated using components of CI, we discussed what could be tweaked or added to incorporate a CI component that would promote the teacher's learning goals.

The interviews lasted approximately sixty minutes and were audio-recorded.

Lesson observation. For each of the observed lessons, the math period was preceded by a recess or lunch. This enabled me to come into the classroom without the students being in there. I selected a corner of the back of the classroom to sit and to set up the video camera on a tripod. I faced the camera towards the board where the teacher would be projecting. Because I was in the back of the classroom, a good portion of the room was also captured, which allowed me to see the teacher as they moved from group to group, but I did not move the camera from its

initial position, so there were times when the teacher was out of the frame. There also was no external microphone. Audio was captured nicely for whole group discussions, but when the teacher was monitoring the small groupwork, there was very little conversation that was discernible. The recording of the lesson allowed me to have an after-the-fact reference.

I selected to sit in the back of the classroom to be as unobtrusive as possible. The teachers had told their students that I would be observing, and for the most part, I felt that beyond the occasional glance my way or towards the camera, I was ignored by the students. My decision to sit in the back of the room was also a way to protect my role as researcher, given to my positionality. Typically, when I was in a classroom in my capacity as mathematics coordinator and coach, I could be found moving from group to group, asking questions of the students, and leaning in to talk to the teacher. In an effort to not slip into habitual practices, I thought it was best to stay stationary.

As the lesson unfolded, I took observational notes. The notes included timestamps of the different lesson segments. I wrote down things I overheard the teacher say that I assumed the video camera would not pick up as well as things I noticed the teacher did when they were out of the video camera's frame. Lastly, I made note of questions that popped into my head for further reflection or to remind myself to ask the teacher during the post-interview.

Teachers' written reflection on observed lesson. At the end of each observation, I emailed the teachers a few questions to respond to regarding the lesson, and asked that they complete the reflection as close to the enactment as possible (see Appendix C). In each case, the teacher was able to respond the same day of the lesson, whether it was right at the end of the school day, or later in the evening. They were asked what they felt the strengths of the lesson were, and if anything surprised them during the lesson. They were asked to reflect on things that

they wished might have gone differently, and what they might change if they were to do the lesson over. For each prompt, they were asked to provide evidence or describe in more detail. I wanted the written reflection to be open-ended, in an effort to capture a more general sense of what stood out for the teacher. But I also wanted to keep the reflection short, to better ensure that the teachers would complete it in a timely fashion, and to respect their time.

Post-Interview for lesson observation. The three participant teachers were interviewed after each lesson enactment (see Appendix D). The post-interviews lasted on average sixty minutes and were audio-recorded. Every effort was made to schedule the post-interviews as close to the lesson enactment as possible, but scheduling conflicts for both the teachers and myself created some fairly large gaps. Three post-interviews occurred the day after the lesson enactment, while one post-interview was unable to occur until eight days after the lesson enactment. The average number of days to lapse between observation and post-interview was three days. This highlighted the importance of the written reflection, to capture the teachers' initial reflections, in the event that the post-interview was delayed.

During the semi-structured post-interview, the teachers were shown their learning goals that they identified during the pre-interview, and were asked how well they felt they attained their learning goals. We discussed what they learned about their students' mathematical thinking and if anything surprised them during the lesson. They were also asked to compare this lesson enactment to a similar lesson they taught the previous year, and they were asked to expand on what changes they might make if they were to teach the lesson again next year. The fact that the interview was semi-structured provided the leeway needed to delve into specific things I heard, observed, or wondered, in relation to the teacher’s enactment of CI and the connection to their

learning goals. For each teacher this varied from lesson to lesson, and I tended to let them drive the interview to some degree, taking cues by the topics on which they might perseverate

An anomaly to the lesson observation cycle. I previously stated that my positionality within this study was precarious, given my prior relationship with the participant teachers. For one teacher, for one lesson observation cycle, I broke protocol, and went rogue - sort of.

During Kay's first lesson observation cycle, I struggled with, and lost, my ability to remain objective. Based on what Kay stated as her learning goals for the lesson and what I observed in the lesson enactment, I knew Kay was not going to meet her learning goals. That in and of itself was not a deal breaker. Throughout the course of the study, no teacher stated in their post-interview that they had attained all of their learning goals, or to a level with which they were satisfied. That was the nature of these teachers, in that they were highly reflective and self-critical. That is also the nature of incorporating instructional practices into one's repertoire.

But what stood out for me while watching Kay's first lesson enactment was that, from my perspective, just a few tweaks to her *what* would make her *why* so much more attainable. As a 6th grade teacher, Kay had two cohorts of mathematics students. In between each class period, the 6th grade students went to lunch. During that time, I approached Kay with a proposal.

I introduced my proposal by asking if Kay felt she had attained her stated learning goals. When she admitted that she had not, I felt comfortable enough that my proposed intervention was in service to the study, driven by my role as researcher, and not coming from the mathematics coordinator lens (although I know the two could never truly be separate).

Kay and I discussed the few tweaks to her *what* that I felt would open up the space for her *why* to thrive, and then I stayed and observed the lesson for the second cohort of students. I adjusted the wording on Kay's written reflection to reflect the fact that she had two lessons back

to back. During our post-interview, I took advantage of the semi-structured nature to allow the conversation to encompass the two enactments. In chapter six I go into more detail regarding this anomaly to the research protocol.

Post Project Interview

Each of the three teachers was individually interviewed at the conclusion of the study, during the last week of the school year (see Appendix A). During the post project interview, we revisited the teachers' beliefs about teaching and learning mathematics. The teachers provided an updated definition of CI that was based on their experiences with the instructional practice throughout the semester. The teachers reflected on the changes they felt occurred to their typical mathematics lesson structure and discussed plans that they had already devised for how they might start the next school year. The semi-structured nature of the interview allowed me to probe for clarification or ask additional questions based on a teacher's response. The interviews lasted about 60 minutes and were audio-recorded.

Qualitative Data Analysis

For each teacher, I transcribed their initial project interview, their pre- and post-interviews from the three lesson cycle observations, and the post-project interviews. I also transcribed the single, mid-reflection interview from Kay's first observation cycle. In total, there were 25 interviews. Along with the interviews, I reviewed and transcribed particular sections of the recorded lessons. I also had access to each teacher's three written reflections as well as the HGS map, with the included TIA, that was created during each pre-interview.

Initial Analysis - Open Coding

In an initial read through of the transcriptions, I applied an open-coding analysis to the conversations. For this open coding, I made notes in the margins of themes that seemed to recur

and moments that seemed pivotal to teachers' understanding of the components of CI. For example, one thing that stood out for me right away was that all three teachers mentioned the use of student roles when asked to define CI during their initial interview. And yet, all three teachers struggled with their incorporation of the student roles for various reasons. I made a note of any conversation around CI roles as a possible theme to be explored in further analysis.

I also looked for alignments and incongruences between what the teachers said in various interviews compared to their actions in the recorded lesson enactments. For example, in Meg's initial interview, she talked at one point in terms of her students working on complex tasks "that's something that we've really built on this year, that grappling with harder problems, and to want to stick with it, and not give up". As I read that, I recalled that later in the semester Meg commented that she felt her students did not have stamina, and that things broke down in her class on *harder* problems. I made a note of this expressed conflict between what she said in regards to her beliefs and practices to what she said as she reflected on her enacted practice. Since my research questions were about anticipated and enacted practices, as well as factors that improved or hindered alignment of beliefs and goals to practices, I wanted alignments and incongruencies noted.

Additionally, while I knew I was going to perform a more thorough analysis of the data through the lens of practicality theory, I did take note of any blatant comments that were related to instrumentality, congruence, or cost. For example, as I read "it’s not easy to find tasks or performance tasks and so it's a real search sometimes", I made a note in the margin of "cost". Marking the overt connections as I saw them would assist with the next step of data analysis.

Second Analysis - Practicality Theory

After making sense of the scope of the data through open-coding, I performed a second analysis of the interview data. For this pass through I wanted to analyze the teachers' comments using the dimensions of instrumentality, congruence, and cost in regards to their enactment of CI (see table 3.1 for an excerpted example). I went through the transcripts one at a time, pulling out statements the teachers made that referred specifically or generally to their current understandings and enactments of CI components. These statements were placed in column B. I then pulled out follow-up statements of beliefs or actions that either confirmed or conflicted with the initial statements. These were placed in column D. I considered what dimension the information in Column D was referring to in regards to practicality theory, and labeled the dimension in column A. In the middle column, I listed whether the instructional practice could be considered in alignment or in misalignment, according to the dimension of practicality theory. In Column E, I jotted down general thoughts or questions I had.

For cost, I looked for statements that referred to time, materials, and resources in comparison to what the teacher expected to get in return. For instrumentality, I looked for statements regarding enactment of components of CI that referenced the teacher's existing classroom structure. Congruence was a bit more complicated, as it encompassed four facets. Statements that referred to the alignment or misalignment with current values and perceptions as well as statements that referred to the attainment of learning goals, were classified as congruence. Also marked as congruence were statements regarding the credentials or belief in CI as a system, as well as statements that compared CI to pre-existing demands present in the teachers' environments.

So, for example, in Meg's initial interview she said "part of the Complex Instruction strategy, or model is that kids know what their role is in their group". I recognized this as speaking to the instrumentality of enacting CI in the classroom, as it was referring to the specific procedures of the instructional practice. However, in her pre-interview for her first lesson observation, Meg stated that she did not think roles would help her attain her learning goals, nor did roles conform with her personality. Both of these data would be categorized in the congruence dimension of practicality theory. Because of the incongruence between the roles and Meg's goals and perceptions of self, the practice was marked "Doesn't align" (see table 3.1).

As I moved through the transcripts, the data required further organization, so that I could make sense of it. Based on what I learned through the open-coding process, I decided to organize this information according to the different components of CI. Table 3.1 shows the Roles portion of Meg's pre-interview for the first lesson observation cycle. She also had a *Tasks* and a *Status* chart. As I moved through the series of interviews, the teachers' alignments with the various dimensions were fluid as their own understanding of CI developed and impacted their practices.

ROLES				
A Practicality Theory Dimension	**B** Statement About CI Specifically	Align / Doesn't Align with Beliefs and/or Goals	**D** Reason for Alignment Classification	**E** Additional Notes
Instrumentality (Specific procedures that have class validity) Congruence (how enactment of the innovation contributes to teacher goals)	222 (ii) - Because when I think of CI, I kind of think immediately of what I learned about assigning roles so that when kids are working in a group, there is some equity in who is doing what and who is responsible for what. 224 (ii) - So part of the CI strategy, or model is that kids know what their role is in their group.	Doesn't align	205 - Should this be - I, should I attempt to make this with team roles? I've done it once or twice but we haven't done it a lot. *Me: Would that help you attain your goals?* Ahhh. Not necessarily. I don't know. I'm still thinking. I'm still debating. So put that, I'm still -	Questioning the use of roles and does not see how roles will help her attain her goals
Congruence (how enactment of the innovation contributes to teacher goals)	222 (ii) - Because when I think of CI, I kind of think immediately of what I learned about assigning roles so that when kids are working in a group, there is some equity in who is doing what and who is responsible for what. 224 (ii) - So part of the CI strategy, or model is that kids know what their role is in their group.	Doesn't align	340 - *So, with those three goals, do you see assigning roles advancing your success of those goals? Or do you see focusing on the roles in addition to everything else will be a distraction?* I'd prefer to not do the roles.	Did I talk her out of them the way I phrased the question? I think she didn't want to use them, but wanted permission to not use them.
Congruence (how enactment of innovation contributes to teacher goals or affects values/identity)	222 (ii) - Because when I think of CI, I kind of think immediately of what I learned about assigning roles so that when kids are working in a group, there is some equity in who is doing what and who is responsible for what. 224 (ii) - So part of the CI strategy, or model is that kids know what their role is in their group.	Doesn't align	351 - *Me: Why do you feel that the roles would get in the way, and not help promote this idea of there are different ways to solve, everyone works a different way* I'm gonna tell you, this is, this is my personality now. I tend to, this is just me. I tend to not, I'm kinda loose. I'm sort of disorganized. I'm kinda seat of my pants. But not really. So, I kind of feel that sometimes these are a little confining. But I see the value. For kids, I do see the value, when we talk about status. When we're trying to bring those kids that have that low status - elevate them. They've got, you know, they are this. They	Sees roles as too confining. Recognizes the connection between roles and status, but moreso for tamping down SUN kids

			become this. But even with that, there's still the kid, that kid that tends to be that take over and push things. They still, that still comes out, even with the roles	
Congruence (how enactment of the innovation contributes to teacher goals)	222 (ii) - Because when I think of CI, I kind of think immediately of what I learned about assigning roles so that when kids are working in a group, there is some equity in who is doing what and who is responsible for what.	Doesn't align	*361 - Me: If the SUN kids were gonna be here, would that change your decision to use the roles or no?* You know, it actually might. And I would give them something that are not the facilitator. They are not - The SUN kids in particular, they would be - I would hand pick what I had them be, or do. Not to make them be quiet, but to give them - and not a backseat, cause they're pretty equal. I mean they're all, you know, they're not, they're all of value. But yeah, the last time we did this, we did, they were here, and we did use these roles. And it worked pretty well. It was ok	Sees facilitator as the one "in charge of the group"? Now counters previous - equal on paper, or in theory, but does she really believe that? So, it worked ok, once, and now abandon?
Congruence (how enactment of the innovation contributes to teacher goals)	146 - Well because, I think those [norms] are pretty important and they are here, on the wall, but it's pretty important that they just hear those again, keep those in mind, because when we work in a group, with a group, that we should all expect certain kind of norms to be followed, and they're just to make the groupwork better, so that we're working well together.	[Norms] Aligns	370 - But I kinda want to see, how do we - are we gonna do with just our norms. Just know, we're working together. I mean, we do talk everybody participates, we encourage participation. We talked about well, what would that look like? 378 - So yeah, I think I'll avoid these [roles], for this task and just see how it goes. And hopefully, going over the norms and talking about them up front, discussing them, will help us, as we're working together. We'll see.	Sees more value in norms than roles. Justification as to why not use roles. Seems kinda laissez faire.

Table 3.1. Excerpt of Second Analysis - Practicality Theory
Excerpt of Meg's Table from her Pre-Interview for 1st Lesson Observation Cycle

Limitations

All research projects have limitations, and this one has admittedly more than usual (Marshall & Rossman, 2011). I make no claims in regards to generalizations or conclusions to be drawn from what I have learned. I present the cases of these three teachers to explain *how* and *why* teachers choose to take up the instructional practice of Complex Instruction. The in-depth, extensive description and exploration is unique to each of these teachers in their instructional context and in relation to their learning goals and beliefs about teaching and learning mathematics. My findings are specific to these individuals and are not representative of educators in similar grades, nor teachers who chose to enact Complex Instruction.

The convenience sample of participants and my positionality within the research setting is an additional limitation. My focus on teachers with whom I had prior relationships most likely affected my data beyond what I acknowledged. The teachers knew that Complex Instruction was the focus of the study, so that most likely influenced their featured lessons and interactions with students. This also might mean it was more likely for me to find shifts in practice more pronounced than what would normally occur. As previously stated, given my role in their school district, the teachers might have tailored their responses to questions to what they thought I wanted to hear. Conversely, I might have drawn on my insider knowledge to make some inferences about what I saw or heard instead of taking things at face value.

Despite the limitations of this study, I feel the methods are justified. This study uses the particular lens of practicality theory to offer a look into why the instructional practice of Complex Instruction is so difficult to enact. This study provides a foundation that can be further explored in future studies with cleaner methods.

CHAPTER 4

MEG: A CASE OF MISMATCHED PROBLEMS AND SOLUTIONS

This case presents the story of Meg over the course of one semester, as she planned for, enacted, and reflected on her instructional practices involving Complex Instruction (CI). We will start with how Meg defined CI. Understanding how Meg interpreted the various components is crucial to making sense of the instructional moves she made throughout the semester. We will then analyze Meg's instructional practice through the lens of practicality theory, but hone in on the dimension of congruence, as that seems to be the main source of misalignment between Meg's anticipated instructional practices, her enacted practices, and Meg's learning goals for her students. We will end where we started, revisiting Meg's definition of CI, in an effort to ascertain the growth towards an idealized version of the practice, as it pertained to her learning goals. Ultimately, Meg's focus on the instrumentality of the CI components, specifically roles, as opposed to the misalignment along the congruence dimension between roles and her perception of herself, interfered with her successful enactment of the practice.

Meg's Initial Understanding of Complex Instruction

Roles

When asked to define CI, Meg immediately referenced student roles. She stated roles clarified students' rights and responsibilities which provided opportunities for equity as they worked collaboratively (initial interview, Jan 6, 2018). Even though roles were the first CI component mentioned, Meg was transparent that she did not use them. “I haven't been as good as I've been in the past at assigning roles, specific roles…we have fallen away from the facilitator, recorder/reporter” (initial interview, Jan 6, 2018).

Despite the fact that Meg indicated an understanding that explicit roles were a way to increase participation and equalize status, she felt roles were too confining for herself and her students. The CI roles did not align with Meg's perception of herself as "loose … disorganized … kinda seat of [her] pants" (pre-interview 1st observation cycle, Jan 26, 2018). Analyzing roles through the lens of practicality theory, there was a misalignment along the congruence dimension between this component of the instructional practice and Meg's perception of herself as a teacher, which prevented her from enacting the roles in her classroom.

As a reminder, one aspect of the congruence dimension of practicality theory refers to how well aligned an instructional practice is to a teacher's current goals, values, and perception of themselves. Despite that Meg recognized that the roles served a pivotal purpose to the enactment of CI, the misalignment between how she viewed the roles and how she viewed herself was too great to integrate that component into her practice. The reasons Meg provided, both initially and throughout the course of the study, as to why she did not use or like the roles, fell squarely in the congruence camp. Her issues were not with instrumentality; it's not that she could not envision how to enact the roles. Students already sat in collaborative teams. Meg had role cards printed and laminated, ready for students' reference as to what their jobs might be in the particular positions. Likewise, she did not mention any reasons that could be considered a barrier of cost, especially given that she recognized the beneficial purpose of the roles towards advancing student equity, as stated in her initial definition of roles. Meg's issues with roles were with congruence, and this will be unpacked in depth later in this chapter.

Tasks

Tasks were the second component Meg spoke of when asked what CI meant to her. Meg spoke at length in her description of CI about it involving a task "that, as stated, it's complex, it's

not an easy task to solve" (initial interview, Jan 6, 2018). Meg continued to elaborate on the characteristics of CI tasks, stating that difficult tasks created an inherent need for students to interact with one another. In addition to increased mathematical difficulty, Meg defined a CI task as having multiple entry points, steps, and operations required for a solution. She stated that CI tasks included visual representations; either given to or created by the students. Meg said she used CI tasks most often as a way for her students to apply recently learned mathematical concepts. Meg described that in a CI task, group members might individually own pieces of critical information. Meg described how this structure created situations where each student could contribute something of value (initial interview, Jan 6, 2018). For Meg, the "concept of being smarter together" initiated with the task in the way that tasks promoted interdependence and allowed for her students to utilize multiple smartnesses (initial interview, Jan 6, 2018).

Analyzing Meg's understanding of CI tasks through the lens of practicality theory, there was evidence of alignment along all three dimensions. For instrumentality, Meg could easily envision the procedures of CI fitting in with her existing classroom structure, such as students working collaboratively on time-intensive rich mathematical tasks. The student desks in Meg's room were arranged in groups of four and throughout the day, regardless of the content, students were encouraged to work collaboratively in pairs or quartets. Meg's daily schedule allotted for 100 minutes of mathematics, which provided the necessary time for students to grapple with the complex tasks.

> And there are some lessons where literally the entire remaining time, might be 45 to 50 minutes spent on a single problem or two that we are working on. And they are often working in teams, either with a partner or teams. And kids are often given the choice of

> who they want to work with but sometimes I'll assign groups as well. (initial interview, January 6, 2018)

Meg was provided instructional curricular guidelines by her district leadership. While she was bound to the district-provided standards sequences, pacing calendars, and common assessments, Meg had some leeway when it came to her daily instructional materials. "There's a lot of stuff in our units that we are able to pull from, but the tasks that I'm trying to find, whether through IM [Illustrativemathematics.org] or something I've come up with myself, or maybe a 3-act lesson, some of Dan Meyer's stuff" (initial interview, January 6, 2018). Because of the structures and freedoms, Meg was able to envision CI tasks playing a prominent role in her teaching context.

There was congruence between CI tasks and Meg's typical instructional practices, in that she preferred her students to engage in rich mathematical tasks as opposed to doing a lot of computation worksheets. It was not uncommon for Meg's students to spend an entire class period on one or two problems (initial interview, January 6, 2018). Meg’s implementation of CI tasks allowed students to explore and do mathematics through the use of various manipulatives, strategies, and in collaboration with peers. This aligned to Meg's values and beliefs about what the best ways were for students to learn mathematics.

Finally, there was an alignment along the dimension of cost in implementing a CI task, with a caveat. As a reminder, cost refers to the effort and required resources to enact an instructional practice compared to the expected return on the everyday teaching demands and the impact on student outcomes. Meg acknowledged the high cost, specifically in planning time, of enacting CI tasks. She stated it was difficult to find "meatier, more complex tasks or problems that allow kids to apply whatever learning goal [they were] working on" (initial interview, January 6, 2018). The conflict became more apparent at her admittance that "it's easier to fall

back on the easy, kind of shallow, surface-level worksheet kind of thing. Cause there is a lot of stuff out there that you can use" (initial interview, January 6, 2018). Meg did not find too many tasks that were at the desired level of rigor or that allowed the students to engage with the mathematics at the depth that she would have liked, so she often would create her own by modifying existing problems. Even with the struggles in finding groupworthy tasks, Meg was willing to devote the effort and required resources to enacting CI tasks in her classroom. "And I also try to stay current. Just in reading and professional reading and try to take advantage of whatever there is out there now for me to learn more from" (initial interview, January 6, 2018).

Meg felt the tasks paid off, in that the students were able to apply their mathematical understanding at a deeper level, and she was better able to assess their understanding of mathematical concepts. Meg also felt the majority of her students enjoyed grappling with the tasks, as evidenced by them protesting when she interrupted their work to make a clarification or to call *time* (initial interview, January 6, 2018). For Meg, the use of CI tasks was justified as the effort required to enact them was balanced with positive student outcomes.

Status & Norms

Status issues were present in Meg's room, and she shared anecdotes of how her students conveyed their perceptions of their peers. In the event that a student who held a position of high status incorrectly answered a question, Meg took note that others in the class had difficulty hiding their "shock" (initial interview, January 6, 2018). When given free rein to select collaborators, students assigned low-status by their peers were rarely sought out, and Meg usually intervened so that everyone had a group. However, when Meg assigned students to groups, it pleased her when group members admitted that a student of lower status had good

insights and contributed to the group's overall mathematical understanding (initial interview, January 6, 2018).

Meg acknowledged status played out in her classroom and that it interfered with student learning. She could easily identify certain students whose contributions were overlooked by their peers, as well as students who almost always took over in group settings (initial interview, January 6, 2018). Meg's main strategy to counter the status issues was through the established norms of doing mathematics in groups. Meg did not mention norms specifically in her definition of CI, but the language of her group norms (see Figure 4.1) was present in her response when asked about the mathematical learning environment in her classroom:

> It's engaging. It's a safe environment to be able to discuss mistakes. Mistakes are made. Mistakes are expected. I've got a poster that says we're expecting mistakes. Students feel comfortable talking to each other about math, sharing strategies about math, wanting to persevere when something is challenging. (initial interview, January 6, 2018)

Meg hoped that the norms that she encouraged the students to engage with helped them to see each other as resources and defined the classroom as a place to learn and grow.

A strong alignment existed in the congruence dimension of practicality theory between the norms of doing mathematics in groups that existed in Meg's classroom and her beliefs about how students could contribute to each other's mathematical understandings. Because Meg believed that her students benefitted from working collaboratively and sharing their mathematical ideas to achieve success, she highlighted the norm that everybody needed to participate. Meg encouraged respectful interactions among her students because she knew that mathematics was messy and mistakes would be prevalent. She wanted her students to accept the mistakes as a part of the process (initial interview, January 6, 2018). Meg's visual references,

such as what is shown in Figure 4.1, and her verbal references to the norms as part of lesson launches, intended to serve the purpose of equalizing status issues among her students.

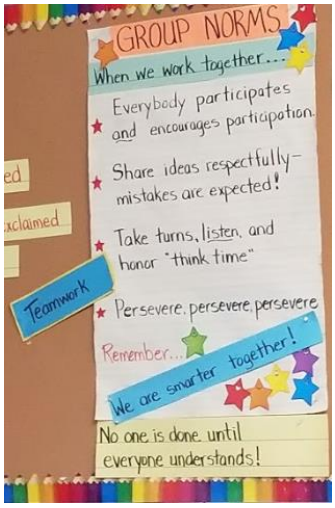


Figure 4.1. Photo of Posted Group Norms.
Poster handwritten by Meg.

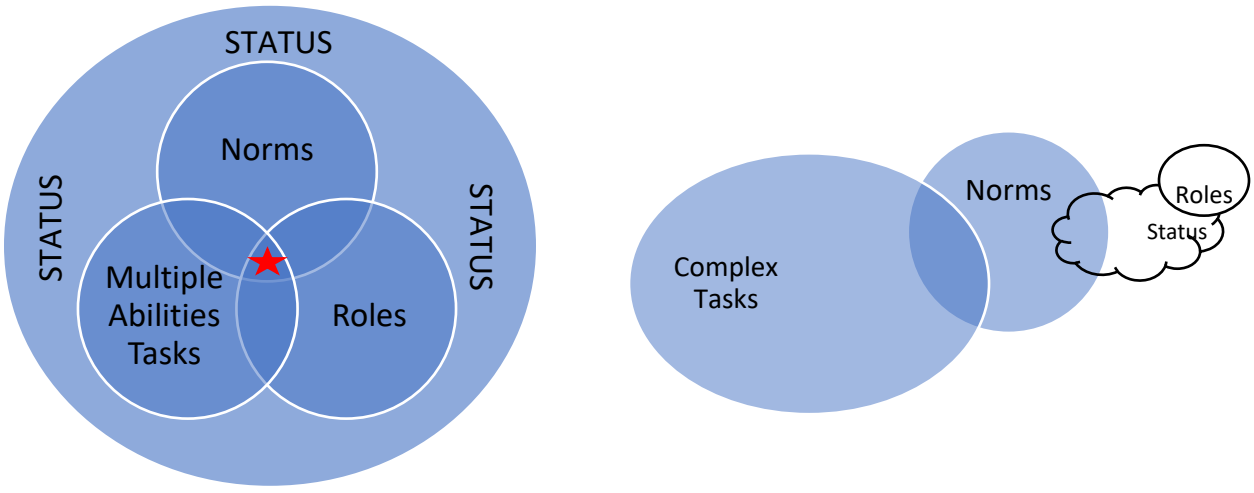


Figure 4.2. Two Definitions of Complex Instruction.
An idealized definition of CI on the left. Meg's initial definition of CI on the right.

Where Meg Started

Figure 4.2 depicts the contrast between an idealized definition of CI on the left to what Meg's definition was on the right. In an idealized enactment, the components and tenets of CI are

clearly defined and they work harmoniously to address issues of status, to make access to the mathematical learning more equitable. In the right diagram, illustrating Meg's initial definition of CI, circular shapes with defined edges depict components for which she had a clear understanding of and defined. Components in clouds represent a more vague understanding or definition. A lack of color denotes components that were not currently a significant part of her instructional practice. The size of the individual components relay the importance of that component to Meg's overall definition of CI. Finally, the juxtaposition of the various components show how Meg described them in relation to each other and her enactment of CI. The visual of Meg's definition of CI serves as a way to map the presence of the components of her instructional practice, the clarity she had around each component, and the connection Meg saw between the various components.

For Meg, tasks were the star of CI. The bigger, the better, and therefore that component dominates her visual. Meg had a very clear, detailed definition of what a CI task entailed, thus the delineated edge as opposed to a cloud. For Meg, the use of a CI task meant that she was *doing* CI. "We do a lot of groupwork. We do do a lot of tasks" (initial interview, January 6, 2018). Meg used CI tasks in her classroom, therefore that portion of the visual is shaded in. Meg also had a clear definition of norms, despite the fact that she did not initially call them out by name. But the visual and verbal references warrant a straight edge to the component as well as being of considerable size. Because Meg encouraged her students to engage in the group norms as they worked collaboratively on complex tasks, the norms are also colored in and are connected to tasks in the visual.

Less clearly defined for Meg was status, hence the cloud. She knew that it was causing problems in the classroom, but her way of addressing it was through the norms. Meg felt that by

reinforcing the groupwork norms, status issues would take care of themselves. Because of the indirect attention to status through norms, status branches off norms, is smaller, and is white.

Meg indicated an understanding of roles as an explicit way to increase participation and equalize status, but by Meg's acknowledgment, she did not use them. Roles are encased in a circle because of Meg's definition, but are not colored due to lack of use. The visual of Meg's CI implementation shows roles as connected to status, per her definition.

Next, we will dive into Meg's enacted instructional practice as it occurred over the course of the semester. Through the lens of practicality theory, we will take a closer look at what factors supported and interfered with Meg's practice as she moved towards a more idealized version of CI in an effort to better meet her learning goals.

Bridging Instructional Practices

Meg, like most teachers, had reasonable, well-developed, but evolving definitions of teaching and learning. Reasonable, in that she could explain what she did and why she did it. Well-developed, in that she was purposeful in what instructional practices she introduced into her classroom ecology. And evolving, as by her own admission of her continued reflection on and tweaking of her instructional practices when she felt they didn't help her achieve her identified goals (initial interview, January 6, 2018). Throughout the semester of study, Meg underwent a progression of sorts, moving from her own conception of what constituted CI, towards a version that aligned more with the intentionality of the enacted practice. With each self-directed tweak to have her practice mirror the idealized version, Meg bridged particular tenets of Complex Instruction with her personal valued goals (Janssen et al., 2014).

Formative Assessment

In Meg's school district there was an intense focus on the concept of formative assessment based upon the work of Margaret Heritage (Heritage, 2011). Formative assessment was a process collaboratively implemented by teachers and students, with the goal to move students' learning forward (Heritage, 2011). Operating as a feedback loop, formative assessment has been shown to be most effective when a lesson's intended learning goals were explicitly stated by the teacher. The indicators of progress toward the learning, called success criteria, were co-constructed by the teacher and the students. This meant teachers needed to focus themselves and their students on what the students would learn, as opposed to what they would do. As an example, the following would be a learning goal for a lesson in a unit focused on learning about ratios and proportions; *Today we are going to learn how different representations show proportional relationships.* The success criteria for this learning goal might be *for students to show proportional relationships using at least two different representations* and *for students to explain how each representation they created shows a proportional relationship*. With the goal and indicators identified, teachers could focus on gathering evidence of student learning (Heritage, 2011). In this section, we will analyze the impact this demand for formative assessment had on Meg's implementation of CI, and thereby the attainment of her learning goals.

First observation cycle. During the pre-interview for the first observation cycle, Meg expressed a tension. On one hand, she was eager to see how her students would do with the planned fraction task, Veggie Tales (see Figure 4.3). She anticipated that they might struggle, as their prior experiences with operations with fractions had only involved two values. "This is adding multiple fractions. So finding a common denominator for not just two, but actually four fractions - which will be interesting to see what they will do with that. 'Cause we have not done

that" (pre-interview 1st observation cycle, January 26, 2018). In Meg's comments, we hear an echo of her definition from the initial interview of what a task worthy being labeled as a CI task entailed. Meg considered this a performance task that allowed her students to apply recently learned mathematical concepts (pre-interview 1st observation cycle, January 26, 2018). This aligned with her use of CI tasks as a summative experience where students applied their learnings, as opposed to a way to learn. Meg felt the complexity of the task made it difficult for her students to solve individually, thereby forcing interdependence among the group.

On the other hand, Meg knew the expectation of district and site administrators was for her to have a posted learning goal, as well as for the students to convey the day's learning if asked. She had concerns that displaying a learning goal and success criteria would strip away much of the inquiry in which she wanted her students to engage. Meg stated she "was not sure how [she] would tweak the learning goal and success criteria to match [her goals of the task]" (pre-interview 1st observation cycle, January 26, 2018).

The tension Meg experienced between staying true to the intentionality of her task and complying with the posted learning goal showed a misalignment along the congruence dimension between CI and an imposed district mandate. The demands of enacting CI in the intended way seemed to be in direct conflict with what Meg understood to be the required demands of the educational system in which she worked.

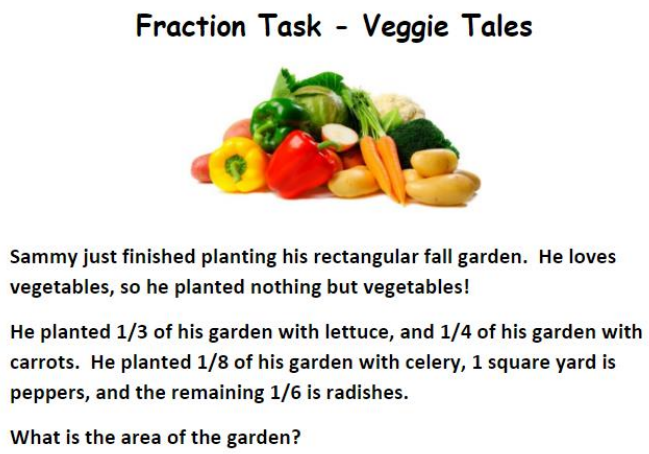


Figure 4.3. Task for 1st Lesson Observation.

During the first observed lesson, Meg projected the following as learning goals:

- I know that common denominators are used to add unlike fractions.
- I know that when we work together, we can learn from each other.

The following were listed as Success Criteria (show what I know):

- Add or subtract fractions with uncommon denominators
- Describe how members of your team contributed to solving the task.

It seemed as though Meg reconciled her conflict by integrating the two practices; CI and formative assessment. The first learning goal and success criteria refer to the mathematical content of the task. These reflect what Meg felt she needed to do to be in compliance with her school and district mandate. However, if we refer back to the short description of formative assessment goals, the purpose of learning goals and success criteria was to focus teachers and students on what the students would learn as opposed to what they would do. Evaluating what Meg presented reveals an emphasis on a process as opposed to what the students might learn by engaging with the task. We might conclude this demonstrated a misunderstanding of the requirements of formative assessment learning goals and success criteria.

The second learning goal and success criteria seem to be a nod towards the tenets of CI. Meg wanted the group norms and student interdependence to be explicitly featured. The addition of the second learning goal and success criteria did that in a way so as to reflect CI in the requirements of the formative assessment practice. During the lesson, Meg had a student read the first learning goal aloud off the projected slide. Afterwards Meg said, "Yeah, we know that, right? We all know that. We're 5th graders. We've been working on this for two weeks, but here's a new one" (observed lesson 1st observation cycle, January 30, 2018), and then she had a student read the second learning goal. Meg's reference to the newness of the idea that students learned from each other as they worked together demonstrated the integration of the instructional practice of CI into the district mandated practice of sharing learning goals and success criteria.

In total, Meg spent 80 seconds introducing the learning goal and success criteria. This was minimal when compared to the 420 seconds that was dedicated to reviewing the group norms she wanted the students to observe while engaged in the task, following the review of the learning goal and success criteria (observed lesson 1st observation cycle, January 30, 2018). However, 80 seconds of front-loading proved far more powerful than Meg anticipated.

In Meg's written reflection after her enacted lesson, she was asked to respond to the following: "Is there anything that surprised you during the lesson? If so, describe this in more detail." Meg replied, "I was pleased (maybe not so surprised) at how quickly many of the students were able to deduce that the common denominator was twenty-fourths. We had not worked with finding common denominators for multiple fractions before" (written reflection 1st observation cycle, January 30, 2018). Meg stated during the pre-interview she felt this would be the most difficult aspect of the task. In addition, her main concern about posting learning goals

was how that would affect the inquiry aspect of the task. Now that the lesson had been enacted, I wanted to explore Meg's ideas further,.

During the post interview, I asked Meg to elaborate on her students' unanticipated success with the task, and inquired if she thought the learning goal had anything to do with it.

> Right. That I set 'em up to find common denominators. Yeah, maybe I should have not even said that to begin with. Do you think that would have been - Uhg! We've drum that into them so much, it's almost like a, ppfh, that's like uh, I mean it's like posted up there. But yeah, I could have just thrown the task at them and said - And see, that's kinda what I struggle with, seriously, sometimes saying the learning goal, this regurgitation of the learning goal, leads them to not maybe figure it out for themselves. Figure out what they're gonna do without me telling. The fact that you know, we say, oh, we're finding common denominators. If I'd said nothing. And even - And that's something to think about when we're trying to apply what we've been learning. That's, that's interesting. (post-interview 1st observation cycle, February 2, 2018)

Meg felt tension between what she understood was required by the formative assessment practices and what she understood to be crucial to CI tasks. This tension was apparent in her circuitous response to the influence of the learning goal and success criteria on her students' performance. While Meg had integrated CI into the practice of posting learning goals, by creating a second learning goal specifically geared towards the tenets of CI, this did not address the root of her conflict between the two practices. The necessity for students to grapple with the context of the problem was null and void at the introduction of the first learning goal and success criteria. The first success criteria outlined which method the students would use to solve the problem. The first learning goal did not allow for student inquiry or multiple entry points into the

task, as it gave the strategy to complete the given operation. Students' reasoning and sense making skills were put on the back burner. Meg once again faced conflict between what she believed was best for student learning, and what she understood to be required of her by the demands of her instructional context.

To circumvent this incongruence, we briefly discussed how Meg might present learning goals in the future. The idea was to create learning goals that were vague enough so as not to give away the mathematical concepts, while still being present enough to satisfy what she understood to be the expectations of site and district administrators. Meg felt that the learning goals she had used "kind of led 'em a little bit by the nose to that's what we need to do", and she really wanted her students to engage in more discussions about the mathematics (post-interview 1st observation cycle, February 2, 2018). Meg wanted to continue to find a way to enact the two practices of using CI tasks and posting learning goals. She needed to comply with the mandate that was imposed, but she did not want to sacrifice what she felt was best for her students' learning of mathematics.

Second observation cycle. During the pre-interview before the second task observation, I circled back to Meg's goal of including CI and formative assessment. I asked Meg what role learning goals and success criteria would have in the Jell-O cake task she prepared (see Figure 4.4). She replied "I'm not going to introduce them. I don't want to give away what you need to do to figure this out. I don't want to lead them into any pre-determined operation. It'll be interesting to see what they do" (pre-interview 2nd observation cycle, April 3, 2018). Meg did not want to mention the word "volume" in the launch of the task, nor tip off the students in terms of any formula. Meg explained that the required focus on specific learning goals would occur at the end of the task, as opposed to at the start (pre-interview 2nd observation cycle, April 3, 2018).

In moving the formative assessment practices to the end of the lesson, Meg was self-bridging, shifting her enactment of the instructional practice of CI closer to an ideal enactment, by attempting to preserve the inquiry she understood to be necessary in a CI task. She had found a way to balance the incongruence she experienced between her vision of CI and her understanding of the requirements for the formative assessment system. By reviewing the learning goals at the end of the lesson, her instructional practice more closely resembled an idealized version of CI, by honoring the productive struggle and student inquiry that was intended, but did so in a way that was doable within her instructional context, keeping in mind the existing demands of her teaching environment.

It would not be fitting for Meg to disregard learning goals and success criteria altogether. In an extreme case, she could be deemed insubordinate. At best, not having learning goals and success criteria visible for each lesson would threaten her status as a conscientious educator. Meg was a rule follower. The blending of CI and the formative assessment practices contributed to Meg's learning goals, and was perceived by Meg as an improvement on her current practice.

How many people will this Jell-O cake serve?

Serving Size = n x 1 cube

(each cube measures one cubic inch)

- **Top layer - 12 inches long**
  8 inches wide
  3 inches tall
- **Middle layer - 14 inches long**
  10 inches wide
  3 inches tall
- **Bottom layer - 16 inches long**
  13 inches wide
  3 inches tall

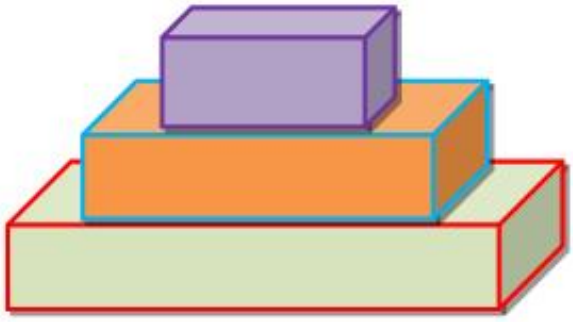


Figure 4.4. Task for 2nd Lesson Observation.

Meg included the following slide in the launch of the second observed lesson, in lieu of the front-loaded learning goal, prior to reviewing the groupwork norms in which she wanted the students to engage (see Figure 4.5).

To Be Successful at this Task You Will Need To:

- be a good listener
- be organized
- gather and connect ideas from everyone
- recognize patterns
- show some measurement concepts.

None of us have all of these traits, but together we are SMARTER!

Figure 4.5. Slide From the Launch for the 2nd Lesson Observation.

From the CI lens, the list outlined the multiple abilities needed for the task. From the formative assessment lens, the list outlined the success criteria the students could use as indicators of their progress of learning. Comparing this observed lesson to the previous one, Meg had modified her instructional practice in an attempt to reconcile her conflict, while she kept her learning goals forefront. It was not stated that students were going to use volume, nor was formula for the volume of right rectangular prisms referred to. Students were allowed to productively struggle. The slide outlining what students would need to be successful during the task met site administration requirements, while putting a CI spin on the actual context.

At the end of the student work time, Meg brought the students to the carpet to debrief the task and check their mathematics. During this time, Meg addressed the lesson's learning goal as planned. "Most of you figured out that we need to find the volume of that cake. How big is it? And it's volume, because it's a three-dimensional cake. And you guys said it was three layers of three rectangular prisms" (observed lesson 2nd observation cycle, April 3, 2018). The mention of volume itself and the necessity to compose the volume of the cake by combining the three layers was no longer an issue, since the students had already completed the task. Meg was able to

validate the work the students had done, and was able to comply with the mandate around formative assessment.

In our post interview for the second lesson, as well as throughout the third lesson observation cycle, learning goal and success criteria did not come up again. For the third task, Backyard Bunny (see Figure 4.6), Meg launched directly into the groupwork norms as her task introduction, choosing to bypass the *To Be Successful at This Task* slide. While Meg did not share learning goals and success criteria at the start of the task, she also did not share the CI version of success criteria in outlining the multiple abilities that would be needed for the task.

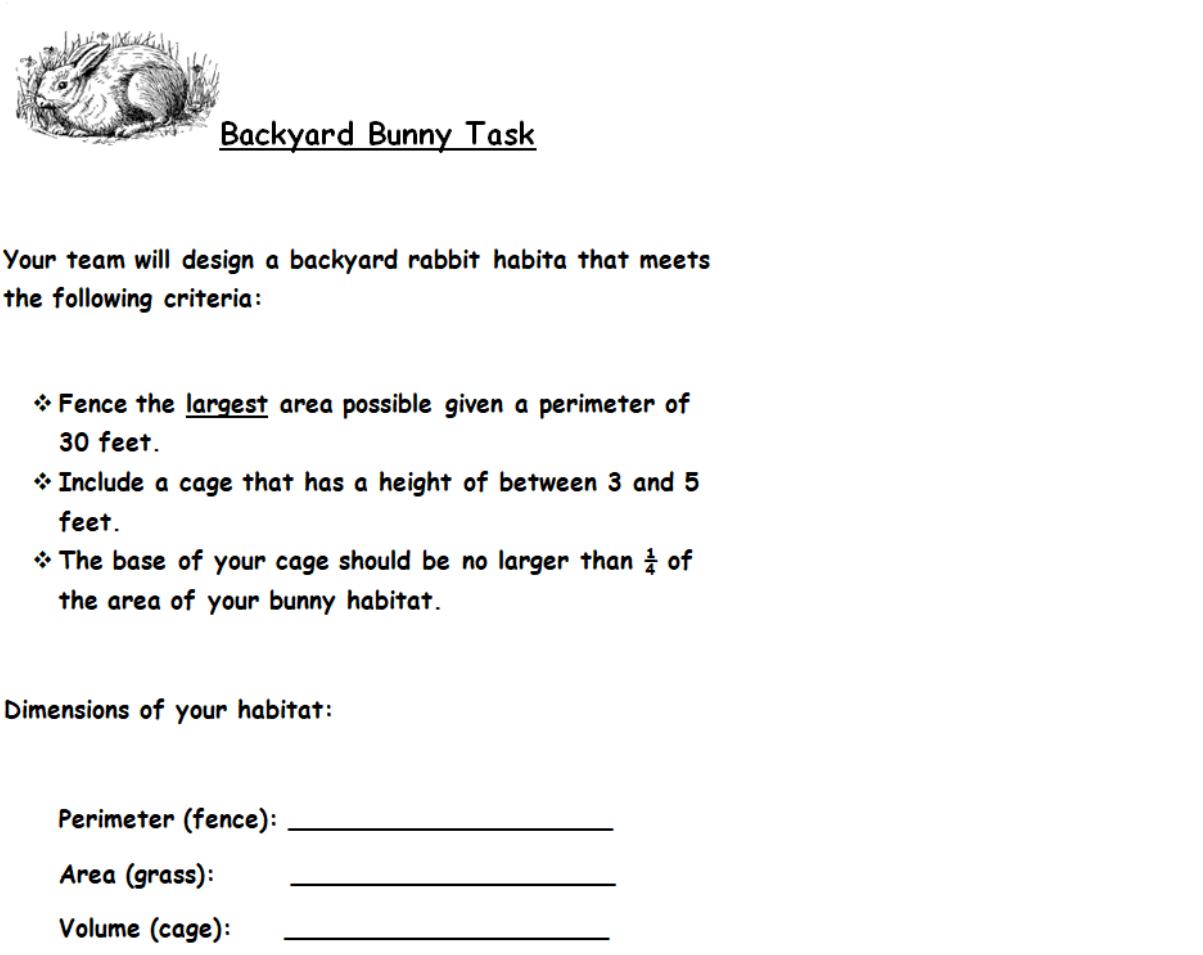


Figure 4.6. Task for 3rd Lesson Observation.

Throughout the lesson observation cycles, another component of CI seemed to take precedence for Meg as she worked to enact the instructional practice in her classroom. Our main focus shifted from tasks to student roles, and how they might address exhibited status issues exemplified by student participation.

Roles

In the next section, we will further explore Meg's CI enactment journey, looking specifically at the component of roles. Throughout the semester, Meg revealed more about her understanding of, and conflict with, student roles. Meg stated that roles were a way to ensure equity and responsibility among the students towards the completion of a task (initial interview, January 6, 2018). She also was very frank in her admittance that she did not assign students roles, because they felt too constraining (pre-interview 1st observation cycle, January 26, 2018). Throughout this study, Meg revisited this tension around roles, as she looked for ways to alleviate issues of status that continued to interfere with students' access to the mathematical learning. As a way to address the status issues that were being exhibited by students' over- and under-participation, roles became a focus for Meg. Meg explored different ways to incorporate the roles to attain her stated learning goals of having all students contribute. To that end, we will see how Meg worked at making roles work for her and her students.

First observation cycle. During the pre-interview, as I questioned Meg regarding the what, why, and how of the lesson for the first observation cycle, we constructed a heuristic goal system (HSG), which outlined her lesson segments, her learning goals, and the preparation that would be necessary for the task, Veggie Tales task (see Figure 4.3). As part of this discussion, when we had moved to the how section of the HGS map, Meg asked "should I attempt to make this with the team roles?" (pre-interview 1st observation cycle, January 26, 2018). In this

moment, I was very cognizant of my positionality and did not want to influence Meg's instructional decisions in any particular way. I turned the question back to her, and asked "would that help you attain your goals?" (pre-interview 1st observation cycle, January 26, 2018). Meg's response was "not necessarily - I'm still thinking. I'm still debating" (pre-interview 1st observation cycle, January 26, 2018). I asked Meg to "put a pin in that", stating that as we moved through the interview process, a part of the HGS and TIA might help her address her question about using student roles (pre-interview 1st observation cycle, January 26, 2018).

As we mapped out Meg's lesson, she had quite a few sub-level learning goals related to each of her lesson segments, but these all seemed to feed into three overarching goals. I noticed that one of Meg's goals seemed to center on students' content knowledge, while another seemed to be focused on the way students would engage with that content knowledge, and the third was more about the instructional goal she had for students' participation and collaboration. I felt the three goals could be categorized into a mathematical content goal, a mathematical practice goal, and a groupwork goal. Meg's main learning goals for the first observed lesson were as follows:

- mathematical goal: students work with operations of fractions with unlike denominators.
- mathematical practice goal: applying prior learning in a real-world context, look for and make use of structure
- groupwork goal: there are different ways to solve problems and we don't all work the same way

While Meg elaborated on all of her goals, she said the following when I asked her to elaborate on her groupwork goals.

> Since I won't have my, and I'm thinking of two students, now I'm talking about, really talking about my students in particular, I won't have two students, individuals, I can guarantee you would've taken over this task, and would've had the answer within 15 minutes. And, they won't be here. So, my goal, I think is to, kind of, for me, sort of

> observe the dynamics of the group. Kind of see, I'm gonna be taking some anecdotal notes about the interaction of the group. How groups are working. Who's stepping up. Who's hanging back. Who's, so I'm kinda looking at status of students and the interaction between students. And it's gonna kinda help me to kinda reform groups in the future, to sort of mix things up a little bit and see if I can't make some combinations for that kid that is maybe afraid to speak or doesn't necessarily want to. Maybe in a different group, they would. So I - we've done a lot of group stuff. We've done a lot of partner stuff. We've done a lot of group stuff, but um...So see, I'm still wondering, should I use the roles? Because that would push them into having a definitive role. So somebody would have to be - you know, they'd have a role. I - excuse me, let me get those little cards. I have 'em in front of me, but I also have them here. (pre-interview 1st observation cycle, January 26, 2018)

Meg's previous comments echo what is in the education research literature regarding the use of student roles. Ideally, enacting student roles allows each student to know what is expected of them, and provides the students an "in" for participation and ability to contribute towards the completed task. Meg made a clear connection between student interactions and status, and how roles might be an equalizing tool. Meg wanted her students to understand there were multiple ways to solve problems, and different approaches had value. The use of roles could open up space for student receptiveness to groupmates' ideas.

Despite acknowledging the benefit roles might have on the students' interactions, Meg was still reticent to use the roles. "So, I kind of feel that sometimes these are a little confining" (pre-interview 1st observation cycle, January 26, 2018). In this confession, Meg spoke to a misalignment along the congruence dimension between an idealized enactment of CI, which

included the use of student roles in an effort to attend to status issues, and how she felt the use of this affected her values. For Meg, the roles added a layer of rigid structure to her classroom culture that normally did not exist. The ecology of Meg's room could be described as organized chaos; productivity existed, students learned. It was active and things were kept pretty loose. The roles were something she was hesitant to explore, despite the acknowledged possible benefits.

> Meg continued.
>
> But I see the value. For kids, I do see the value [in roles], when we talk about status. When we're trying to bring those kids that have that low status - elevate them. They've got, you know, they are *this*. They become *this*. (pre-interview 1st observation cycle, January 26, 2018)

In Meg's initial definition of CI, she had associated status with norms, but in the previous quote she pinpoints roles as way to disrupt status issues. She recognized roles might help students of low status identify more as contributors to the mathematical tasks at hand through their identification with the roles. When Meg said "they become *this"*, I interpreted that to mean the students became the role they were assigned and it provided them one way to contribute to the intellectual work of the task. For example, the Questioner could make sure everyone's ideas were heard and considered. The Resource Monitor could summon the teacher. Roles could provide all students an *in* to the task.

Meg could also get on board with using the roles with her students labeled as gifted, as a way of curbing their enthusiasm that could cause them to overtake the learning.

> I would give them something that they [gifted students] are not the facilitator. I would hand pick what I had them be, or do. Not to make them be quiet, but to give them - and not a backseat, cause they're pretty equal. I mean they're all, you know, they're not,

> they're all of value. But yeah, the last time we did this, we did, they were here, and we did use these roles. And it worked pretty well. It was ok. (pre-interview 1st observation cycle, January 26, 2018)

It is interesting that while stating the roles were equal, Meg specifically called out Facilitator as a role she would actively not assign her students labeled as gifted. It was unclear whether this was because the students perceived this role as one of authority, or if Meg did. Past experience had given Meg the idea that with the students labeled as gifted, roles helped in tamping them down, although she was clear that her intention was not to silence them nor have them not collaborate. I understood this to be the idea that there was only so much space, and for certain students to participate, others needed to participate less.

Ultimately, Meg did not convey much faith that the roles could do an adequate job of alleviating status issues. "But even with that, there's still the kid, that kid that tends to be that take over and push things. They still, that still comes out, even with the roles" (pre-interview 1st observation cycle, January 26, 2018). She was unconvinced that the roles were stronger than some students' personalities, and ultimately kids would be kids. The fact that the students labeled as gifted would not be in class on the day of the observed lesson, and they were her target audience for roles, was the nail in the coffin on the roles discussion in the pre-interview.

> But I kinda want to see, how do we - are we gonna do with just our norms. Just know, we're working together. I mean, we do talk everybody participates, we encourage participation. We talked about well, what would that look like? And I'll let them know, when I come and talk to you, I'm not necessarily gonna talk to the person that wants to tell me, here's what we did. I'm gonna maybe talk to Maggie, who maybe I've seen is just sitting and , you know, you're maybe not - You know you better encourage Maggie to

> you know, share your ideas Maggie. You know, blah, blah, blah. So, they'll know, it's not gonna, I'm not looking for one of you to have the answer for your group. So that's, and you know, we've talked about that too, also. So yeah, I think I'll avoid these, for this task and just see how it goes. And hopefully, going over the norms and talking about them up front, discussing them, will help us, as we're working together. We'll see. (pre-interview 1st observation cycle, January 26, 2018)

Meg felt with the students labeled as gifted not in the room, and through a reinforcement of the classroom norms, she might be able to circumvent status issues, and ultimately stated that she'd "prefer to not do the roles" (pre-interview 1st observation cycle, January 26, 2018).

During the post-interview, I asked Meg to reflect on her conscious decision to not use the roles. She had been very focused on the idea that roles created too much structure, and that they might be most beneficial to students of higher status, as the students of lower status were confined by the roles (pre-interview 1st observation cycle, January 26, 2018). However during the first lesson enactment the students labeled as gifted were not in attendance, and Meg still identified examples of not all students equally accessing the mathematical learning.

In our post-lesson interview, Meg reflected on the various group dynamics, but she specifically focused on one group of students. At the end of the lesson enactment, Meg had asked her students to provide feedback to each of their groupmates. The students were asked to write one way each teammate contributed to the success of the group on a post-it, including a post-it for themselves (see Figure 4.7) (observed lesson 1st observation cycle, January 30, 2018). Meg shared the feedback that one group had left for one student (post-interview 1st observation cycle, February 2, 2018).

- *Andy helped all of us.*
- *Andy did most of the work and helped me figure out the problem.*
- *Andy did all the work.*
- *I did all the math*

Figure 4.7. Peer Feedback on Groupwork Goal for 1st Lesson Observation.
Feedback from one group directed towards one student.

Meg said that roles might have helped this groupwork more cohesively (post-interview 1st observation cycle, February 2, 2018). While she stated that Andy was a "pretty good math kid", she also added "that might not have been the best combination of people" (post-interview 1st observation cycle, February 2, 2018). Based on the feedback, Andy was clearly a valued member in terms of this group achieving the mathematical content goal, but the feedback also begs the question, did each individual attain the mathematical content goal. We might conclude that Meg had a dilemma. Meg still did not like the idea of roles. The roles clashed with her perception of herself as an educator, as a person (pre-interview 1st observation cycle, January 26, 2018). However, Meg had evidence that she was unable to achieve the learning goals she set for her students (post-interview 1st observation cycle, February 2, 2018). With Andy doing all of the work for this group, Meg's attainment of her goal was unsuccessful.

Meg stated that she would like to try the roles on another day to see if it made a difference in the way that the students engaged with each other and with the mathematics in the task (post-interview 1st observation cycle, February 2, 2018). Meg made a move to self-bridge between her current instructional practices towards a more idealized version of CI. I am calling this self-bridging, as opposed to bridging which is used in the practicality theory literature, due to the fact that the shifts made to Meg's instructional practice were her own. I did not suggest or intervene in a deliberate way. Meg recognized that the student dynamics featured in Adam's group and others were not what she was going for, and the desire for her to achieve her instructional goal of all students participating outweighed her desire to keep the structure of her classroom *loose*. In Table 4.1, Meg's self-bridging sequences are outlined to show the progression of her instructional shifts in regards to the use of roles as a way of addressing issues of status that impacted student participation.

Second observation cycle. During the pre-interview of the second observation cycle, Meg declared she would use two of the CI roles; Facilitator and Resource Manager.

> We said let's see if using those roles make any difference in- not that last time was bad, it just, to see how imposing those roles - I feel for me, I like those two roles the most, because it just kinda gives a little bit of structure to the way the group operates. (pre-interview 2nd observation cycle, April 3, 2018)

Due to the phrases of “let’s see” and “a little bit of structure” one might conclude Meg was still reticent regarding the use of student roles in her classroom environment. She spoke of imposing the roles, as though it was something done to the students and herself. And there was continued reference to the structure that roles created. The two identified roles were the ones Meg felt the most comfortable with and had the least amount of impact on the current structure of the class.

Some of Meg's reluctance perhaps stemmed from a lack of understanding about how roles were used as a tool to equalize student access to the mathematical learning. "The facilitator's gonna maybe go around the table and see what have you got so far, you know, just kinda, I don't know. I'm still, I'm not sure. Resource manager is more clear to me" (pre-interview 2nd observation cycle, April 3, 2018). As this quote shows, Meg had a vague definition of each role, but seemed unable to connect the roles' purposes to equalization of status. Meg seemed to see the roles as way to manage behaviors of particular students, as opposed to allowed students to contribute to the tasks in "intellectually significant ways" (Featherstone et. al., 2011, p. 43). For example, she thought she might make a particularly active student the Resource Manager, so they would have opportunities to get out of their seat (pre-interview 2nd observation cycle, April 3, 2018). Meg planned on strategically assigning the roles during her second lesson enactment.

Which she did.

And that's as far as it went. She passed out the role cards, but she did not address them further. The role cards were left on the side of students' desks, ignored by the students, and received no follow-up or reinforcement by Meg (observed lesson 2nd observation cycle, April 3, 2018). The role of the roles was so inconsequential even I had forgotten they were in play during the lesson, and did no follow-up during our post-interview for the second observation. This particular interview did occur eight days after the observation due to scheduling conflicts, which might have impacted the debrief discussion.

While we did not talk about the use of roles specifically during the post-lesson interview, Meg and I discussed several instances from the enacted lesson where group dynamics were affected by what Meg perceived as issues of status. Meg spoke of two groups in particular that had group members working in isolation. In one group, a student had correct reasoning but they

made a calculation error. However, this student was generally an under-participator. They did not share their thinking with the other members of their group, nor did their groupmates inquire as to what they had come up with. The students had no opportunity to catch and correct the calculation error (post-interview 2nd observation cycle, April 11, 2018). In the other group Meg referenced, there was a different student who was an under-participator, but they were also viewed as high-status by their peers. This student was content with having everyone get out of their way, so they could figure things out on their own. The other members of the group left the student to work in isolation, because they knew that student generally arrived at correct answers, and the group would have a completed task to submit (post-interview 2nd observation cycle, April 11, 2018).

In hindsight, these situations might have been instances where roles might have positively impacted the group dynamics and individual student participation. Thinking back to Meg's earlier comments "so I'm kinda looking at status of students and the interaction between students. Because that [roles] would push them into having a definitive role" (pre-interview 1st observation cycle, January 26, 2018), perhaps specific student roles would have opened up a space for more equitable student participation in this observation cycle. But because roles were not a part of the instrumentality of the class procedures, they did not come to mind to either Meg or myself as a way to address the access and equity issues we both observed. We were unable to envision the procedure within the constraints of Meg's teaching context.

Third observation cycle. Given the previously identified status issues related to student participation, I asked Meg about her goals specific to student participation, (not roles), for this lesson in the pre-interview.

> I've struggled with that. Yeah, because I...It's a big struggle, I think for all of us, to make this equitable. To make this Complex Instruction that we're trying to get at, to be an

> equitable, and every group is different. It's not like we're having the same problem. Each team has their own unique little problems and their own unique little personalities that are contributing to the problem. You know what I mean? It's like, it's individual things. I think we're gonna go over the norms again. We're gonna review the norms. It's what I'd like you to think about. And we've had debriefs about why this didn't work well, so I think the last time I told you the sticky notes were related to what worked well in your group and what didn't. And some of the feedback I got was, yeah, somebody kinda tried to take over, somebody tried to be the person doing everything. And then the reverse, the exact opposite, Somebody who will go unnamed, did nothing, did nothing but try and get us off task, and it did get us off task, and we struggled because somebody was just disruptive. So we're gonna talk about the norms, um, I don't know. I'm, I've been struggling about, with what I'm gonna do to try and make this kinda a more cohesive working situation for us all. I don't know. Incentivize it? I'm not sure. I'm not sure yet. I think I am gonna still use the two roles I have been using. I'm not at the end of the school year gonna say now we're gonna use all four roles. I'm still just gonna have a Facilitator and a Resource Manager. (pre-interview 3rd observation cycle, May 7, 2018).

Meg's angst was quite apparent in this monologue, and there were some recurring themes from earlier in the semester. There was an expressed desire to *do* CI and get it right, as she felt this was the key to equity in her classroom. Despite the fact she was struggling to implement certain components, she was not willing to abandon the instructional practice. But she knew it was not working yet. She had personal observations, as well as student feedback, regarding participation issues among the groups. Meg still put precedence on the norms as the key to equalizing status and impacting student participation, so she had a renewed dedication to review them with the

class. She still entertained the idea of the roles, but could not commit to more than the two with which she felt comfortable. And as she went on, the incongruence between Meg's perception of herself and the roles came out again.

> You know what, here I'm gonna be very honest with you. I am not, just, my personality, is not the one that is the role-person kinda personality. So I'm - Even as a teacher, I'm invalidating it even, because they'd raise their hand, and I say, is this a group question, but I wasn't paying attention, is the resource manager, is the right person asking the question. I'm not even validating the roles. So I feel like why am I trying to - ok, I'm not gonna do the roles. Cause I can't. I'm not. I, part of me in my brain is like, I don't like these, I don't...It's just my personality. And I feel guilty, because I love the Complex Instruction aspect of things, but it's this role thing that kind of - cause I'm not that way. I'm more like blah. I'm not that type A enough to do that. (pre-interview 3rd observation cycle, May 7, 2018)

Meg's perception of the rigidity of the roles and how she saw herself as a person was preventing her from implementing student roles in her classroom. From one monologue to the next, Meg had moved from saying she would use the two roles, to saying she could not use them at all. She understood that if she had not bought in to them, her students were not going to see them as something of added value (pre-interview 3rd observation cycle, May 7, 2018).

And then, in stepped Meg's talent to self-bridge. "Can I modify the roles?", to which I replied "you can do whatever you want" (pre-interview 3rd observation cycle, May 7, 2018). Again, being very cognizant of my positionality, I was careful to not lead Meg in any particular direction when it came to decisions she made regarding her instructional practice. While yes, my

presence did convey a message, in the fact that she knew I was researching her enactment of CI, I did not want to purposefully further impact her instructional decisions in any way.

A common thread in Meg's rhetoric from the start of this study had been the desire for her students to work collaboratively, to make sure everybody participated, and that everyone's ideas were heard. This was not happening to the level she wanted with her current instructional practice. Meg believed that CI was the way to achieve her goals, and that the roles in particular were a way to achieve her goals. But due to a hard and fast incongruence between her perception of the roles and how Meg saw herself, she could not jump all in. She wondered if a tweak, to not only her instructional practice but also to the component of CI with which she was struggling, would help her attain her learning goals of equalizing student participation by address some of the issues of status.

Meg proposed that students would still have roles, but their roles would be that of "contributors" and "listeners". Students would contribute an idea to the group and then they would not get to contribute another idea until everyone else in their group had a turn. At that point, students could contribute again. Meg felt this procedure would allow all students to participate in, but not dominate, the conversation. To help the students keep track of who had and had not contributed each round, Meg thought they might have tokens of some sort that could be "paid" each time they spoke (pre-interview 3rd observation cycle, May 7, 2018).

As Meg continued to envision this new procedure playing out in her classroom environment, certain students' personalities came to mind, and she started imagining how this new procedure would fall apart. "Then Andrew will be throwing their tokens at somebody across the room. Brandon will sit there with 4 tokens piled up and never ever put one in to talk. I don't know" (pre-interview 3rd observation cycle, May 7, 2018). Meg was having difficulty

envisioning the instrumentality of this procedure within the constraints of her teaching context. This led Meg to add extra layer of structure to the component. She decided she needed one student in each group to play the role of Facilitator. That student's job would be to keep track of the paid tokens, encourage students that had not participated, and hold back students who contributed too often (pre-interview 3rd observation cycle, May 7, 2018)..

Despite the fact that these ideas were originating from Meg as a way to reach her learning goal of equalizing student participation, she still was not wholly convinced. "Cause I've struggled with the roles ever since we've done all of this. Just kinda trying to peg a little kid into this, I don't know" (pre-interview 3rd observation cycle, May 7, 2018). Throughout the semester, Meg referenced how roles conflicted with her perception of herself as a teacher. But here, the incongruence took a different twist. Meg referred to the negative impact she felt roles had on students' perception of themselves. This was interesting because it countered a claim from the first observation cycle, where she stated roles had the ability to elevate some students and get them to see themselves in particular ways (pre-interview, January 26, 2018).

And, once again, the rigid structure that she felt roles imparted on her teaching environment was central for Meg. As she added layer on layer, she expressed concern with how "regimented" and "formulaic" the shift in her practices might become (pre-interview 3rd observation cycle, May 7, 2018). Meg consistently seemed to push back on any type of structure, but it could be argued that the lack of particular structures was what allowed for the status and participation differences among her students. She was stuck in a vicious cycle. But, she was willing to try.

> Maybe this'll make me work my way back into the value of roles. I don't know. Or make it work for me. I mean it has to, I have to buy into, or, you're right. If I don't adhere to

> them or really pay attention to them, my kids aren't going to. (pre-interview 3rd observation cycle, May 7, 2018)

With Meg's reference to "buying into" the roles, she speaks to the congruence that would need to be in place between the practice and her own beliefs and perceptions.

During the third observed lesson, Meg introduced the participation popsicle sticks to the class. Each student in the group was given three of a particular color, and a small bucket sat in the center of the group's table where the sticks were supposed to be deposited after a contribution. Meg also reviewed the Facilitator role, and described their job as keeping track of who participated. She provided some sample phrases the Facilitator might say to their groupmates to encourage them to contribute an idea or to ask them to wait until others had shared (observed lesson 3rd observation cycle, May 8, 2018).

For the most part, while the students engaged in the Backyard Bunny task (see Figure 4.6), the buckets remained empty and the sticks lay on the desktops or became something with which the students fidgeted. In one group, about ten minutes into working on the task, one student put a stick in the bucket after a contribution. A second student contributed, and the first student took a stick from them and put it in the bucket. A third student added a stick even though they had not participated. And then that was it. The rest of the sticks stayed on the students' desks (observed lesson 3rd observation cycle, May 8, 2018).

In Meg's words, the use of the participation popsicle sticks was "hit and miss" (post-interview 3rd observation cycle, May 9, 2018). Meg noticed that some students had their sticks in the group's bucket, but she did not necessarily witness the students using the sticks as intended. She wondered if maybe they did it after-the-fact as a compliance. Meg felt the issue was with the sticks themselves and wondered if the process would have gone better if the

Facilitator used tally marks to track groupmates' contributions. And while she was at it, she proposed a change to the name of the person who was taking data on participation, from the common role of Facilitator to Participation Captain (post-interview 3rd observation cycle, May 9, 2018). Because of this, it seemed now as though Meg's identified struggle was more along the lines of the instrumentality dimension of practicality theory as opposed to the congruence dimension. Rather than focus on how roles did not match her preferences, Meg was now considering the structures and procedures that might make roles work in her classroom.

In light that Meg still had not attained a level of satisfaction regarding her learning goals, she continued to contemplate what shifts might be made in her instructional practice to bridge towards an idealized enactment of CI, as she felt that was the best way to attain her goals. "I'm not giving up on some sort of strategy where, whether it's - I wonder, I'm thinking now even…" (post-interview 3rd observation cycle, May 9, 2018). Table 4.1 lays out the incremental shifts that Meg made along the way in regards to roles in an effort to attend to unequal participation that might have stemmed from issues of status. Through each phase of the study, Meg had made a self-bridging move to incorporate student roles into her instructional practice in service to addressing status issues she observed. Meg had not found all the answers, nor permanently fixed all the problems, but due to her reflective nature, she continued to think about what might be possible in her classroom.

Regular Practice (as described in initial project interview) Jan 6, 2018	Have not used them this year as in the past. Wants to see what students can do with just the norms.
1st Lesson Observation Cycle Pre-interview - Jan 26	Conscious decision to not use them - students labeled as gifted will not be there. Structure goes against who Meg is as a person.
1st Lesson Observation Cycle Post-interview - Feb 2	Says will use the roles next time in an effort to balance the observed dynamics among all students.
2nd Lesson Observation Cycle Pre-interview - Apr 3	Says will use two of the roles - facilitator & resource manager, strategically assigned.
2nd Lesson Observation Cycle Post-interview - Apr 11	The "use" of the roles so inconsequential, ignored by students, Meg, and myself.
3rd Lesson Observation Cycle Pre-interview - May 7	~Says will still use two of the roles - facilitator & resource manager. ~Says not going to do the roles. ~Lands on Talking / Participation chips.
3rd Lesson Observation Cycle Post-interview - May 9	Talking sticks were still inconsequential since the students hadn't really used them before. Decides she wants Participation Captain who tracks tally marks of students who participates.
Post Project Interview May 18	I do want to use roles. I want to feel good about the roles. And I do want to have all kids have a role, because that does bring them in. That gives them status right there, that they have a role.
Idealized Enactment	"We assign students formal roles, with well-defined duties that draw them into the mathematics at stake in the task". (Featherstone, et al., 2011, p. 42)

Table 4.1. Overview of Meg's Self-Bridging Sequence
Outline of the tweaks to her instructional practice in regards to use of roles

Meg's "Final" Definition of Complex Instruction

As Meg anticipated, enacted, and reflected on her instructional practices throughout the semester, her understandings of the components and tenets of CI had shifted and changed. In the next sections we will explore some of those changes.

Roles

"I do want to use roles. I want to feel good about the roles. And I do want to have all kids have a role, because that does bring them in. That gives them status right there, that they have a role" (post project interview, May 18, 2018). Over the course of the semester, Meg transitioned from not using assigned roles, to declaring she intended to use them from the get-go in the fall with the new cohort of students; even if that meant she had to "make them work slightly differently" (post project interview, May 18, 2018).

During the last interview, Meg stated that roles needed to become "second nature" for the students (post project interview, May 18, 2018), in that they needed to be interwoven within the instrumentality of the classroom environment. She recognized her forays into self-bridging towards an idealized CI enactment fell flat when it came to roles, since the students were not well-versed in the procedures and expectations, and the students didn't own the roles. Meg felt an introduction to the roles at the start of the year was the way to ingrain this particular procedure into the instructional context for her and the students (post project interview, May 18, 2018). She acknowledged she needed to address the misalignment in instrumentality, for roles to have an opportunity to thrive in her classroom environment.

Meg also continued to struggle with a misalignment of congruence with the roles. Meg wanted to continue to modify the roles in a way that allowed her to find meaning in their purpose. As long as a strong incongruence existed between the roles and her beliefs, Meg would still struggle with the enactment of roles. She was intrigued by the modification she had made to the Facilitator, turning it in to a Participation Captain, and could clearly connect the function of the role in supporting her instructional goal of increasing student participation (post-project interview, May 18, 2018). The increased congruence between the roles and her learning goals

reinforced Meg's decision to continue to make them work. In addition to Facilitator, Resource Manager was a role she felt comfortable with, although even at the end, it was unclear how Meg saw the role contributing towards the instructional goal. It seemed as though she understood the job mechanics, but at a more surface level. But, she had two roles that she intended to implement the next year.

Lastly, Meg was better able to articulate a connection between the roles in CI and the impact they could have on a student's status. Meg understood roles increased one's value to the group process and they were a way to "pull a couple of kids that aren't necessarily, that just sit back" (post-project interview, May 18, 2018). This further strengthened the alignment along the congruence dimension, as Meg's beliefs about students and how she wanted them to participate could be addressed by the enactment of the roles. This was a positive move forward, as previously Meg had only connected status to norms. By understanding roles also served to positively affect student status, the argument for use was strengthened.

Tasks

"And then I do want to keep working on, at least once a week, maybe twice a week, a groupworthy task. Not Complex Instruction per say, where - Because, well Complex Instruction and Groupworthy tasks go together" (post-project interview, May 18, 2018). Meg's perception that the task defined her instruction as CI had shifted. She was not using the two terms interchangeably, but recognized that tasks were a component of the larger CI system. She no longer held the opinion that a big task with multiple moving parts was enough to say she was doing CI in her classroom. This didn't happen so much as a direct result of lessening the focus on tasks, but because the focus on other CI components had grown.

In addition, Meg recognized an interdependence between tasks, norms, and roles for CI to work the way she envisioned and contribute to her learning goals.

> But my problem is I do do a lot of group worthy tasks. I don't necessarily overlay the Complex Instruction procedures over them. And I feel like I need to do more of that. Like the roles. Actually using the roles. Actually reviewing the norms. I will hand them all out a task. You gotta work as a team to solve it, and that's all I'm doing. I'm not saying here are norms, blah, blah. You're the facilitator. I'm not doing that. We probably do a good solid, pretty good group worthy task, at least once a week, but I don't overlay it with the Complex Instruction kind of, procedural parts. And I think I want to do more of that next year. (post-project interview, May 18, 2018)

Meg speaks to the instrumentality of doing groupworthy tasks as a part of the CI system. She conveyed an understanding that the task alone was not enough and that she need to explicitly reinforce the norms and roles that accompanied the task. Meg's definition of a CI task had become more nuanced and less emphasis was placed on difficulty and complexity. Now a task worthy of being labeled CI opened up "equitable, accessible mathematics for everyone, and [had] everyone realize the value in everyone's contribution" (post-project interview, May 18, 2018). A task became a CI task when students were "listening to each other and they were giving, a true ear to everyone, and they have gained respect for everyone's understanding" (post-project interview, May 18, 2018). A task was defined more by the norms that were enacted rather than by how "tricky" the problem was (pre-interview 1st observation cycle, January 26, 2018). There was a strong alignment along the congruence dimension between Meg's understanding of CI tasks and what she believed good mathematics teaching and learning should be.

It was not a complete 180, however. There was still mention of "meatier problems to dig into", but Meg did retain the commitment to allow students to "just get in and dig around and muck around try and figure things out, without as much overlay as I have given in the past" (post-project interview, May 18, 2018). Meg wanted to honor the inquiry process that was a large part of a CI task and to that end needed to remain mindful of the impact stated learning goals had on that process. Meg was going to continue to push against the incongruence she felt between the district mandated process of posting learning goals and what she wanted her students to experience when they engaged with a groupworthy task.

Status and Norms

"And of course, the norms, I mean we always have our norms, but we're gonna roll them out" (post-project interview, May 18, 2018). Meg began the semester referring to groupworthy norms. She reviewed the norms she wanted the students to engage with at the start of each task. She had a beautiful poster on the wall. But it seemed as though Meg owned the norms and not the students. Throughout the semester, Meg observed and commented on instances across the groups when the norms broke down. Students worked in isolation, while others dominated. Students did not question those of higher status, even if they were incorrect. Students gave up on the tasks. Meg recognized that the norms were not a specific part of the procedures of the classroom, which explained why the students experienced difficulty sticking with them.

To counter this problem with instrumentality, Meg devised a plan for the next year to do more modeling of what the norms looked like and sounded like with the students. She concluded students needed to practice what it felt like to work in a group when the norms were being enforced. She wanted students to learn how to talk to, listen to, and question each other. If students could experience and engage in the group norms, Meg conjectured their status would be

elevated, in that they would then know "what it felt like to be a participant of value in a group" (post-project interview, May 18, 2018).

Where Meg Ended

> I've come back to what I think it should have meant, and I kinda lost sight of that. Is that it's making math accessible to all my students using tasks that are a little, I say groupworthy, meaning they're more than a quick-solving task. That sets up the scenario where students, who may not necessarily have the status that they would because of so many different reasons, but we try and equalize the playing field so that kids can be heard. So Complex Instruction could be any sort of task where they've got to work together to solve the task and we've gotta set it up so that everybody is playing a part and everybody feels heard and everybody wants to be heard. And it would be my job to try and break down some of those barriers somehow that's keeping that from happening. (post-project interview, May 18, 2018).

In Meg's comment above, there is a clear shift in her understanding of CI. At the start of the semester, CI was described more as individual components with some interrelatedness, but more compartmentalized. Here, we see CI more as a systemic way to equalize learning opportunities for students. As Meg's self-bridged, her definition of CI, and thereby her practice, became closer aligned with an idealized version. Figure 4.8 depicts the ideal version of CI at the top. The bottom left figure depicts where Meg started in her understanding of CI, which is contrasted with Meg's ending definition on the bottom right. While Meg’s description did not meet the idealized version of CI, the moves she made through the semester of study resulted in a revision which was more aligned than where she started.

Meg's definitions of each component were clearer and each component was present in her instructional practice in some form at the end, thus the defined edges in the figure and the addition of color. Tasks had become more right-sized, and were no longer the main component of CI. Roles moved from a vague, unnecessary component of enacting CI, to a concrete feature of the system. Meg was clearer on the understanding that norms and roles needed to be explicitly addressed in conjunction with the task, in an effort to counter status issues among her students. The interrelated components in the new figure exemplify the interdependence.

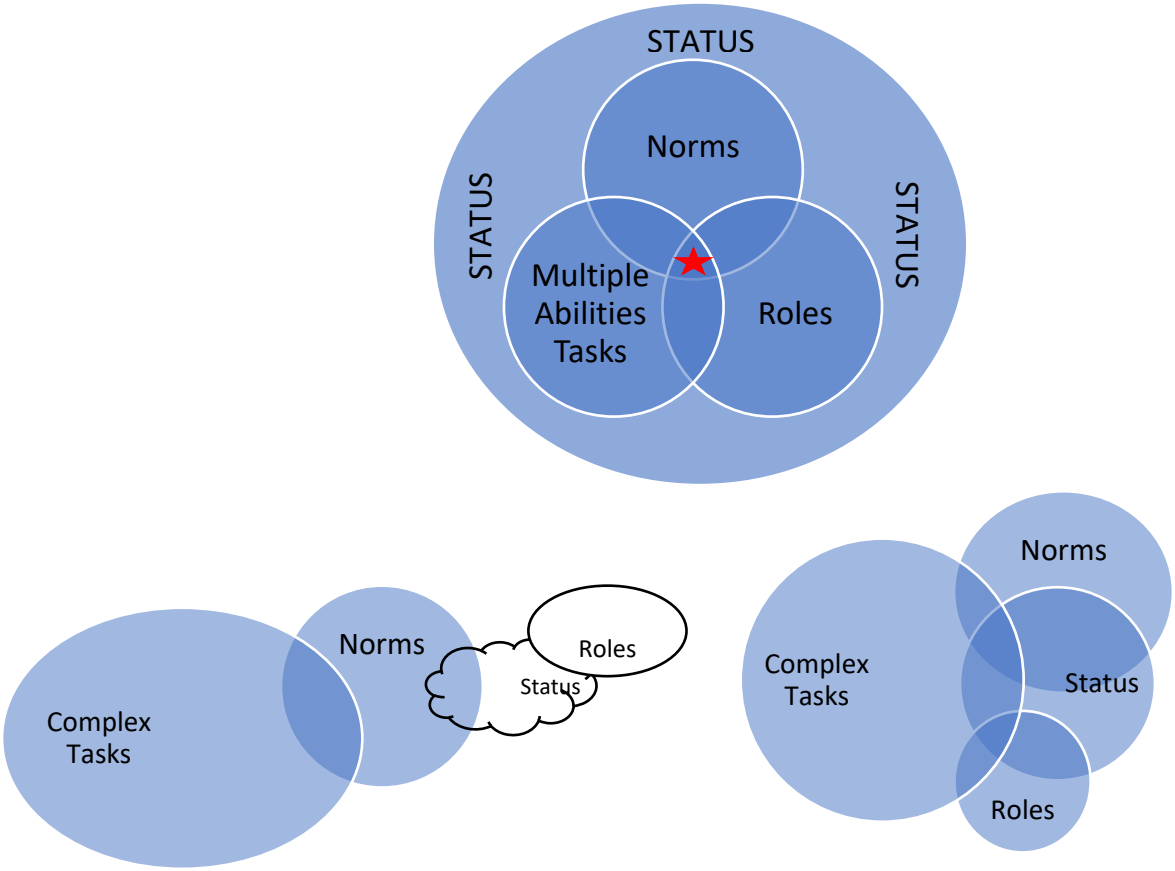


Figure 4.8. Three Definitions of Complex Instruction.
An idealized definition of CI top, center. Meg's starting definition of CI on bottom left and her ending definition on bottom right.

Discussion

In the research literature there are examples of the theoretical underpinnings of CI as well as the positive impacts its enactment has had on mathematics instructional practices of particular systems (Boaler & Staples, 2014; Horn, 2012). There are also frameworks, such as practicality theory, which help to explain how and why teachers might choose to take up instructional practices (Doyle & Ponder, 1977; Janssen et al., 2013). This study is helpful in bringing these two constructs together, as a way to better understand the process by which individual teachers take up CI specifically, and the struggles and successes they experience along the way. In this chapter, Meg teaches us several things about the adoption and adaptation of CI. I will briefly discuss Meg's enactment of CI through the lenses of cost and instrumentality. However, the majority of this discussion will be focused on Meg's struggles of enactment within the congruence dimension and her solutions to these struggles via the instrumentality dimension.

Cost

Meg profited from a mostly balanced cost-benefit ratio when it came to her enactment of CI. While the finding of or creating tasks was reported as time intensive, the learning gains Meg believed her students experienced from engaging in such tasks made it worth the expended effort. Negative costs associated with the increased amount of instructional time were mitigated, due to procedural structures that already existed in the classroom, such as the extended block of instructional time. Meg did not report any negative social costs from enacting CI. If anything, she described an opposite phenomena, as she described her students' dismay when she would stop them from working on a task to summarize the learning and move on. As a general rule, it seemed as though the effort and required resources to enact CI in Meg's classroom aligned with and were in service to the expected positive impacts on student outcomes.

Instrumentality

Along with the cost dimension, there were factors that could be labeled within the dimension of instrumentality that supported Meg's enactment of CI. Within Meg's existing classroom structure there were aspects that allowed for ease of integration of CI procedures. The layout of Meg's classroom was already organized in a way so as to encourage collaboration among the students. Meg's allotted instructional time provided the space for students to grapple with rich tasks that often took extended class periods. Meg had flexibility regarding which instructional resources were used for instruction, which allowed her to incorporate or modify tasks that were better aligned with the tenets of CI. While there were some social and behavioral aspects of the classroom, such as the unequal participation among the students, that did not support the enactment of CI, the foundational structures were in place. These structures allowed Meg to focus more on less tangible features, such as integrating her enactment with existing demands in her learning environment and addressing issues of status.

Congruence

This analysis demonstrates the complexity of the congruence dimension in practicality theory and the power of influence it might wield over a teacher's instructional practice. Throughout the semester as Meg's practice unfolded, she grappled with several aspects of CI. As she planned, enacted, and reflected on her instruction, it became apparent that her main struggles stemmed from two different aspects of the congruence dimension.

Existing demands of the teaching environment. Initially, Meg struggled with enacting CI at the same time as she complied with the required formative assessment practices. She believed students should be engaged in inquiry-based, rich tasks that allowed for students of multiple intelligences to access and contribute towards the mathematics. Meg also understood

that she was required by her district and site administration to explicitly outline a learning goal. These two ideas stood in contrast to each other for Meg.

However, it could be argued that Meg's understanding of both the nature of CI tasks and the requirements of stating a learning goal were not aligned with the original intention of each innovation. Meg seemed to focus on the term *complex* in the instructional aspect. She interpreted the phrase as meaning many moving parts and pieces, as opposed to the way that a task might have certain characteristics to allow every student access. In regards to the formative assessment practices, we saw examples of stated goals that highlighted process over learning, which was not aligned with the practice's intention. Because Meg's understanding of each practice was different from the intention of the practice, she perceived a conflict that probably did not exist. While Meg's position was that the two practices were incongruent with each other, it might be that Meg's understanding of each practice was incongruent with the intentionality of each practice.

Teachers manage multiple innovations, stemming from district, school, and personal initiatives. Often times, teachers feel these innovations are in conflict with one another, and in many cases that might be the case. However, one's full understanding of the intentionality and goals behind an innovation can help to clarify its purpose and procedures. In the case of CI and formative assessment practices, I would argue there was not an incongruence, and would cite as evidence the move Meg made to share the smartnesses students would need to be successful in their task in the second observation cycle. The highlighting of the multiple intelligences gets at the heart of what a CI task is, as well as helped address the learning and learning goals Meg had for the lesson. The story of Meg reveals an important consideration as we think about how and why teachers take up instructional practices. Full understanding of the various instructional practices teachers either choose or are required to take up can help teachers see existing

alignments between the practices. As teachers make connections across instructional practices, the effort required to enact instructional practices can decrease, and various components of practices support the enactment of others.

Perception of self. Meg struggled to enact CI in another aspect of the congruence dimension. Student contributions were unequal, and Meg desired to curb the over-participation of certain students while encouraging intellectual contributions from under-participators. The use of roles was defined as a way to address status issues (Featherstone et al. 2011), but Meg felt the roles were not congruent with how she saw herself as an educator. In contrast to the loose, organic flow that Meg strove for in her classroom environment, Meg viewed roles as too structured and confining for both herself and her students. The magnitude of change required for Meg to enact roles in her classroom environment was huge, as it required a change to her core beliefs system. To be in a position to successfully enact roles, Meg would need to change her perception of the roles as constrictions and view them as supports to her learning goals of increasing student participation and access.

Congruence as the struggle, instrumentality as the solution. And yet in Meg's attempts to adopt and adapt the component of roles, she addressed instrumentality as opposed to congruence. Meg's self-bridging moves throughout the semester focused on the enactment of the procedure as opposed to addressing the misalignment with her beliefs. While the shifts in the procedures of the role enactment that Meg made were slight, and therefore much easier for her to envision and incorporate into the existing classroom environment, those moves were not necessarily productive, as they did not get at the heart of Meg's conflict.

In this, the story of Meg reveals an important consideration as we think about how and why teachers take up instructional practices. Among the various moving pieces that most

instructional practices contain, there can be a multitude of reasons why certain parts just did not work. As teachers reflect on their instructional practices, and as those in an instructional support position coach and facilitate, we must be mindful of identifying the root cause of why instructional practices fail, in an effort to apply an appropriate solution.

Through the process of self-bridging, Meg ended the semester in the process of moving her instructional practice closer to an idealized version of CI. Meg made changes to the instrumentality of CI to address the struggles she felt with the presentation of content-based goals and student roles in service to what she believed were essential goals to the learning of mathematics. Meg felt it was unacceptable that not every student in her classroom had equal access to the learning. The self-analysis with which Meg approached her teaching and the goals that she had for her students' learning allowed her the opportunity to grow and refine her craft in ways that aligned with her beliefs, goals, and character, in a sustainable way.

CHAPTER 5

LEE: A CASE OF THE ENDS JUSTIFYING THE MEANS

This case presents the story of Lee over the course of a semester as she enacted the tenets of Complex Instruction (CI) in her 3rd grade classroom and reflected on that practice. Similar to Meg, Lee experienced struggles with her enactment of CI in regards to existing demands of her teaching environment and with student participation. However, Lee took unique solution paths to resolve her struggles. Lee's beliefs and goals about teaching and learning mathematics remained forefront in her anticipated and enacted versions of CI throughout the semester. She deepened her understanding of what it meant to have a CI classroom and moved her practice closer to an idealized version of the innovation. I will start with an understanding of where Lee began the semester; her definition of CI, her instructional context, and her beliefs about teaching and learning mathematics. I will then analyze Lee's instructional practices and decision making through the lens of practicality theory. I will end where we started, revisiting Lee's definition of CI, in an effort to ascertain the growth made towards an idealized version of the practice, as it pertained to her learning goals. Lee was able to circumvent some of her struggles with the enactment of CI by attending to the dimensions of congruence and cost.

Where Lee Started

When asked to define Complex Instruction (CI), Lee succinctly outlined a student-directed instructional practice involving groupwork and assignment of student roles. Through this structure, students had the opportunity to explore concepts and take ownership of their learning. However, Lee admitted that CI did not play a prominent role in her classroom. Lee stated she needed to do better at consistently implementing the strategies to help her students learn them so they might function productively in groups (initial interview, January 9, 2018).

Beliefs About Teaching & Learning Mathematics

In an effort to ascertain what alignment might exist in regards to the dimensions of congruence, instrumentality, and cost of enacting CI, I probed further into Lee's typical instructional practices and beliefs about teaching and learning mathematics. While Lee struggled to define the best way to teach and learn mathematics, (as in her opinion it varied in as many ways as number of students in her classroom), she was very comfortable in outlining what she believed was not the best way. "Just very teacher-directed. Write this down in your notebook. Copy this. Do this problem. And for kids who are successful, just give them a longer problem" (initial interview, January 9, 2018). The description Lee provided for the type of instruction that did not align with her beliefs seemed to fall into the direct-instruction camp of teaching methods. Lee did not see herself as the giver of knowledge and her students as receivers. Lee did not buy into the idea that learning was memorization and a series of rote steps to be performed.

When encouraged to expand her thoughts, Lee provided the following as the most important characteristics of good mathematics teaching. "Willingness [for the teacher] to learn … and try something new. Ability to provide multiple hands-on experiences to reach different learners' needs. And the teacher having a deep understanding, so they can help students question their own understanding" (initial interview, January 9, 2018). Lee positioned herself as a learner as much as her students. Learning was seen as something plastic, to be explored and experienced, as opposed to a static imposition. From these descriptions and non-examples, it seemed as though there was an alignment along the congruence dimension between Lee's values, beliefs, and her perception of herself as a mathematics educator, and some of the components and tenets of CI, such as norms, roles, tasks, and their role in addressing status issues that impeded learning.

Lee's Instructional Context

Beliefs were only part of the narrative of the complexity Lee called teaching. When asked what other variables influenced her instructional practices, there was a described incongruence between what Lee envisioned for her instructional practices and the demands she faced on a day-to-day basis in her classroom, school, and district environments. "My practice is influenced by whether or not I'm being observed" (initial interview, January 9, 2018). Lee elaborated:

> Yeah, if I know that the principal is going to walk through the room, then I make sure I am more closely aligned to what all the other teachers are doing...And they're uncomfortable when I am doing something that looks to them like it's unfamiliar…and they're not comfortable showing that they don't understand the connection…So, I try to make sure they understand what I'm doing and they feel comfortable. And whatever their buzzwords are, I try to hit them, so. Cause it just makes life easier. (initial interview, January 9, 2018)

The yielding nature Lee exhibited in the previous train of thought would repeat throughout the semester, as she balanced her role of teacher with that of employee. Lee seemed very cognizant of the systemic influences to her practice. Lee understood there was some level of congruence expected across all third grade teachers. To that end, an administrator's comfort level would outweigh Lee's beliefs about teaching and learning on occasion. Lee's veteran status meant that her formal observations were minimal, and she knew technically she was allowed to veer from the traditional teaching script (initial interview, January 9, 2018). However, the use of language such as "easier", "buzzwords", and "comfortable", when discussing her teaching context suggested she did not want to make waves, in an effort to be perceived as a team player.

Status

Lee's context not only impacted her instructional practices, but also played a role in the status issues among her students. Lee wanted her students to see themselves and their peers in a particular light when it came to mathematics learning. "But even though I've told them a million times… the thing I value and respect the most is when somebody knows they don't understand something and wants to keep working cause that actually makes your brain muscles stronger" (initial interview, January 9, 2019). However, she struggled to shift the students' perceptions of what smart in math meant. "There's a pride in being the first and the fastest. So, it's discouraging" (initial interview, January 9, 2019). Even though Lee tried to downplay it as much as possible, speed played a prominent role in students' perceptions of smartness in mathematics and who was assigned high status in the classroom. "And I just, I don't know where that comes from…They didn't get it from [last year's teacher], and they're not getting it from me, but yet it's already in there" (initial interview, January 9, 2018).

Because all the students in Lee's class qualified as gifted, one might assume status would be a non-issue. And yet, status issues persisted. Lee felt that something or someone conveyed the message that status mattered, and she wrestled to identify the source. "I don't know, I mean maybe, I, we must be as teachers, we must be doing something unconscious that's giving them that idea, so even though, consciously I'm totally against that, there must be something I'm doing" (initial interview, January 9, 2019). In addition to stemming from herself, Lee also bandied around other sources, which included other teachers, parents, and even an innate competitiveness within the students themselves (initial interview, January 9, 2019).

Lee listed other characteristics besides speed that impacted how students' viewed each other's mathematical proficiency. Students' abilities to explain their thinking received positive

recognition from their peers. Explanations didn't necessarily need to be complete or correct, but a confident delivery seemed to elevate students in the eyes of their peers. Confidence equaled deference. The students who were quiet or shy and did not exude confidence in their mathematical thinking tended to be seen as less proficient by their peers, as were the students whose desks were messy (initial interview, January 9, 2019).

While Lee did not call status out by name, she did share that observed interactions showed some students serving as bystanders while others were more active participants. There was an undercurrent belief by some students that faster was smarter, and being pulled into a small group for extra help was punitive (initial interview, January 9, 2019). Lee was unsure from where these beliefs stemmed and wanted to actively combat them. She felt that establishing the tenets and components of CI into her classroom environment and instructional practices might be a way to address the participation issues she observed among her students (initial interview, January 9, 2019).

Lee's Initial Definition of Complex Instruction

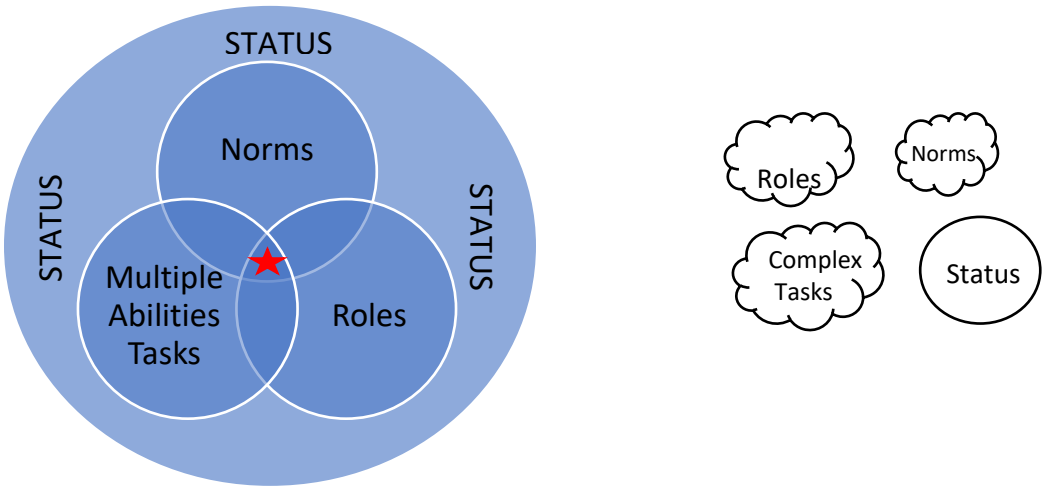


Figure 5.1. Two Definitions of Complex Instruction.
An idealized definition of CI on the left. Lee's initial definition of CI on the right.

Lee's version of CI is depicted by the graphic to the right in Figure 5.1. In an idealized enactment, depicted on the left, CI components and tenets are clearly defined and they function cohesively to equalize students' access to mathematical learning, through alleviating issues of status. In Lee's visual, circular shapes with delineated edges depict components she clearly defined. Clouds illustrate components for which Lee had more vague definitions. The size of the shape conveys the relevance to Lee of the component to CI as a whole. The larger the shape, the more crucial the component was to Lee's definition of CI. Color indicates components that were currently being enacted in Lee's instructional practices, while a white shape conveys components that are not present. Lastly, proximity of the shapes is a way to make sense of how Lee used the components of CI. Connected shapes depict components that worked in conjunction to promote Lee's learning goals. Isolated shapes show components that worked individually.

Lee recognized the components of CI, but had yet to formalize them in her classroom. She had strong beliefs about teaching and learning mathematics, and was drawn to the concept of complex tasks as a way of supporting those beliefs. However, she struggled to bring alive complex tasks within her teaching context due to perceived contextual constraints. Lee knew that students could be assigned different roles and that they could assist in ensuring that all students participated, but she acknowledged that she was "not where [she] wanted to be" in regards to roles (initial interview, January 9, 2018). Lee alluded to norms in her talk regarding beliefs about teaching and learning and who was smart in math, but norms were not specifically defined. Status was clearer for Lee, and something she saw as a barrier to her students' mathematical learning. But beyond her own verbal reinforcing, she did not have systems in place to counter the status issues (initial interview, January 9, 2018). Lee even entertained the idea that she unconsciously aided her students' status issues (initial interview, January 9, 2019). The CI

components were separate entities in Lee's instructional context. The components were of similar size in her visual although norms were slightly smaller, given they were not directly addressed. Lee began the semester without having a cohesive definition of CI, nor any of the components of CI established in her instructional practice.

Bridging Instructional Practices

Throughout the semester, Lee experienced varying levels of success in her integration of CI into her instructional practices, but she did not give up. She progressed in her sense of what constituted CI and moved towards a more idealized form of the enacted practice. Lee was particularly focused on the use of student roles to increase equitable participation and address status issues among her students. Each self-directed tweak to have her practice mirror an idealized version aided Lee in bridging particular CI tenets with her personal valued goals. As Lee became more confident in her understanding of CI, she felt more comfortable integrating the instructional practice into her teaching context, thereby dissipating the misalignment in the congruence dimension of practicality theory.

First Observation Cycle

Task. As previously stated, Lee did what she could to be compliant within the existing demands of her teaching context. At times, compliance came at the expense of an alignment between Lee's instructional practices and beliefs. For example, Lee wanted to combat her students' idea that faster was smarter. However, in an effort to align with the broader learning goals of her third grade team and school site, Lee occasionally provided her students with practice worksheets on their basic multiplication facts. She administered fluency timed tests every couple of weeks and recorded students' scores monthly. "It's a requirement. So, I do have to do that as part of my job" (pre-interview 1st observation cycle, January 21, 2018). Lee

understood that data production was expected. She also understood that visitors to her classroom during any of these tasks would feel quite comfortable in their recognition of *math*, and would not question Lee's skills or motives. Lee felt this would not be the case when it came to her implementation of CI (pre-interview 1st observation cycle, January 21, 2018).

Lee understood students needed to be fluent in their multiplication facts, and acknowledged that computational weakness might interfere with students' abilities to do more complex, interesting problems (pre-interview 1st observation cycle, January 21, 2018). But Lee also wanted her students to make sense of the numbers they were manipulating and reason about relationships between various factors and products. Lee planned a task for the first observation cycle that aligned more with her mathematical content goals of estimation and sense making as opposed to a task that promoted rote memorization (see Figure 5.2). In this task, students would use their understanding of multiplication, along with their reasoning skills, to compare and order values represented in various ways. This task not only contributed towards Lee's learning goals, but the cost of enactment was quite low. Lee was able to draw upon a pre-existing task that she had observed enacted the prior year.

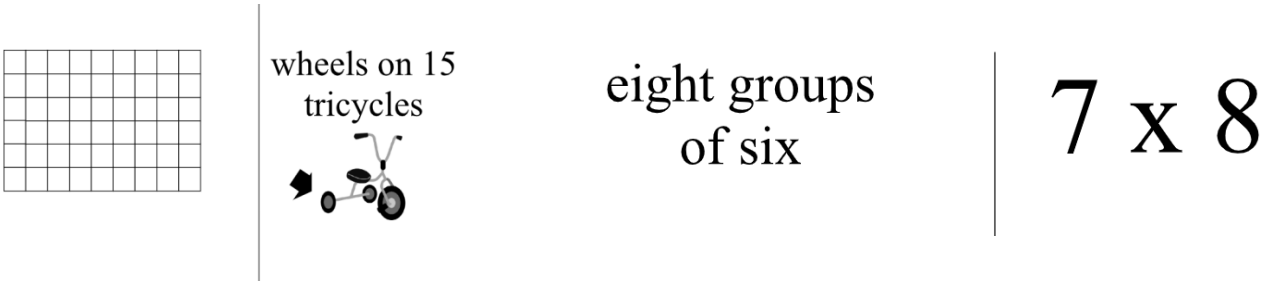


Figure 5.2. Samples of multiplication scenario cards
Adapted from a task developed by Marcy Wood.

Roles. Similarly to Meg, Lee believed roles to be a critical component of CI to equalize student participation and address issues of status that interfered with all students' learning. During the first observation cycle, Lee planned to introduce her students to the four common

roles of CI: Facilitator, Questioner, Resource Monitor, and Recorder/Reporter. Lee's students had previous informal experience with groupwork, but Lee felt that the lack of deliberate roles had resulted in unequal participation among the students (pre-interview 1st observation cycle, January 21, 2018). Equalizing participation was a priority for Lee. Her stated focus regarding the roles during that first lesson was for all students to adhere to their roles, which she felt would increase their participation in the mathematical task. For the Resource Monitor in particular, Lee clarified that this would be the person to receive the task card from her, and that they were the only ones to get out of their seat to gain her assistance. She also singled out the role of Facilitator as the student whose job it was to keep the group on task. Lee hypothesized the Success Criteria she was required to display at the start of each lesson would be a helpful tool for the person in that role. It would serve as a checklist they could use to monitor the group's progress towards the mathematical content goal (pre-interview 1st observation cycle, January 21, 2018).

For Lee, addressing participation and status issues among her students were as important as the mathematical content of the task. Lee believed that the culture fostered in a classroom where CI practices were evident paved the way for all students to access the mathematical content. Lee felt the roles used in CI played a big part in students' access and equity to the learning (pre-interview 1st observation cycle, January 21, 2018). To that end, mastering of the mathematical content goal might not be possible for all students without simultaneously addressing the goals around participation and status. Lee commented that when "Complex Instruction was done correctly, ideally all kids were participating" (initial interview, January 9, 2019), and therefore went all in with student roles from the start.

Enacted instructional practices at times do not mirror anticipated practices. For example, during the first observation cycle, Lee got admittedly stuck when it came to enforcing the roles

and advancing student participation. She struggled to see how the role cards assisted students with their participation (post-interview 1st observation cycle, January 28, 2018). Lee had the students reread their role cards to redirect them when they looked to her for assistance with the task. She verbally reinforced that everyone needed to participate. In an effort to make the quieter or more shy group members' ideas more accessible to the group, Lee described how she positioned herself across the table for verbal interactions. "But I didn't know what to do beyond that" (post-interview 1st observation cycle, January 28, 2018).

Lee expressed particular concern in regards to the role of Resource Monitor. She had focused on that role at the start of her lesson, feeling it was the most attainable. She understood that this person was responsible for gathering materials for the group as well as calling her over for group questions. She also believed this role would be most accessible to students, in that the responsibilities were very concrete. Lee felt this particular role could address specific inequities in terms of student participation. "I tried to give my resource monitor cards to the more quiet, lower status kids. What I would notice is I'd go to the table, and it would be the dominant kid who would want to ask the question" (post-interview 1st observation cycle, January 28, 2018).

As enacted, the role of Resource Monitor did not assist in equalizing students' participation. Lee found the Resource Monitors were not asking group questions. She also worried that any assistance she provided to answer questions would over-scaffold the task (post-interview 1st observation cycle, January 28, 2018). Lee had extended the responsibility of the Resource Monitor to not only include summoning her for group questions, but they were the only one who could ask her questions. Lee expressed surprise when I clarified that once she was called over to the group by the Resource Monitor, she had the freedom to ask any one of the group members what the group question was. "Okay, that's good, and that, I think, will take

practice" (post-interview 1st observation cycle, January 28, 2018). Lee acknowledged the clarification of the role and made a commitment to shifting her practice to better align with the purpose of the role, in an effort to equalize participation among her students (post-interview 1st observation cycle, January 28, 2018).

Instructional context. Despite the alignment along the congruence dimension between the task and the roles with her learning goals, Lee was apprehensive about the perception of the mathiness of enacting CI to outside observers. “If somebody came, and they didn't want to see the other stuff and said, 'What are you doing? How is this a math lesson?' which they probably wouldn't say with this, but they say with a lot of things” (pre-interview 1st observation cycle, January 21, 2018). Lee worried about being competent enough in her own understanding of CI to adequately explain the importance of having learning goals aligned with the tenets of CI, such as *everyone participates* and *we are smarter together*, alongside more traditional mathematical learning goals. She felt observers might not see the math because they would be distracted by the "CI stuff" (pre-interview 1st observation cycle, January 21, 2018). But because the "CI stuff" aligned well with Lee's instructional goals, and given she was a participant in this study, she was willing to risk it and handle any consequences after the fact.

Putting her struggles with roles aside, Lee was excited to be enacting CI and reflecting on her instructional practice. She conveyed an appreciation for the built-in accountability measures of observations and interviews, due to her participation in this and other projects.

> I would try to do them anyways, but I’m human. And I’m tired. That’s why I do stuff like this to myself. If I’m not kinda being watched, I’ll do less. You know what I mean? So, this is helping me…it’s helping me stay on the path. (post-interview 1st observation cycle, January 28, 2018)

In this excerpt, Lee spoke to why innovation enactment might fail, citing the cost of enacting an innovation. Lee, like most teachers, had many demands on her time, and could only expend effort in so many ways. This might partly explain why CI did not take off in Lee's classroom when she was initially exposed to the instructional practice a few years prior. All of CI's moving pieces, compounded with the lack of congruence between the innovation and Lee's instructional context, increased the cost of enactment to the point that the cost-benefit ratio was unbalanced. Being a participant in this study lessened some of those costs, so that Lee could explore the enactment of the practice in her classroom in greater depth.

Second Observation Cycle

Task. At this point in the semester, Lee had moved from using ready-made tasks to writing her own. However, she quickly realized it was not as easy as anticipated. One issue Lee ran into as she began writing tasks was that she left out vital information or made incorrect assumptions about student understandings. "I don't realize it until they are enacting the task. Then they'll catch things that I didn't clarify, that I needed to have in the initial task" (pre-interview 2nd observation cycle, March 26, 2018). This was not only frustrating to the students, but Lee found it distracting as well. While the students were engaged in the task, Lee was tied up in logistics, and correcting errors or clarifying content. So much so that she was unable to observe and follow up on her students' interactions to the level that she wanted (pre-interview 2nd observation cycle, March 26, 2018).

Another issue Lee experienced in writing tasks came in trying to find a balance between the mathematical content and the superfluous discussions her students could so easily get sidetracked by. She felt that some tasks were too mathematically arduous, while in others, the students got caught up in the triviality of the details that had no mathematical impact. She

wanted the students to be engaged by the context, but also have meaningful mathematical discussions (pre-interview 2nd observation cycle, March 26, 2018).

For the second lesson observation, Lee's mathematical content goal was for students to solve problems in a real-world context using the four operations (pre-interview 2nd observation cycle, March 26, 2018). In service to this instructional goal, the students planned a vacation in their groups. They were given a budget, along with a list of associated costs for activities, lodgings, and restaurants. The issues Lee experienced with previous tasks continued. During this lesson enactment, Lee's students ran into clarification issues in terms of unknown vocabulary and missing pricing structures needed for the successful completion of the project (observed lesson 2nd observation cycle, March 28, 2018). Logistically, Lee realized that information sheets and recording sheets were not strategically distributed among the different group members. They needed to be reshuffled to increase the interdependence and equalize participation among the students (post-interview 2nd observation cycle, March 29, 2018). In her concern about the content being too rigorous, and mindful of her tendency to overshoot, in this task Lee created a situation where the mathematics was too simplified. Therefore the task did not aid the students in meeting Lee's mathematical content goal. Lee knew her task writing was a work in progress, but she was not deterred (post-interview 2nd observation cycle, March 29, 2018).

> I knew the task would be flawed the first time around and while the math today wasn't as meaningful as I'd hoped for, I still feel as if it's time well spent because they were interested, engaged, involved in some math, and practicing important social/life skills. I will improve on it. It's still better than worksheet reviews, math coloring pages, and whole group lessons where the teacher is doing the majority of the talking. It basically failed but I'm okay with it, because I know it will lead to a quality experience for them

soon, possibly tomorrow and if not, on Tuesday for sure. I learn how to modify lessons best by watching students. (written reflection 2nd observation cycle, March 28, 2018)

Even though the task for the second lesson observation did not assist Lee in meeting her mathematical content learning goals, she felt the experience brought her students closer to her groupwork goal of equalizing student participation. The components of tenets of CI were still contributing to Lee's values and beliefs of teaching and learning mathematics, and therefore was worthy of continued refinement.

Roles. While Lee could see connections between the task and student engagement, she continued to struggle with roles as a strategy to ensure all students participated. "It wouldn't be in there if it didn't work, but … when I assign the roles, I am not doing it well enough yet for that to get everybody participating" (pre-interview 2nd observation cycle, March 26, 2018). Despite the fact that she felt she did not have a handle on the other roles, Lee felt that she and her students had managed to incorporate the role of Resource Monitor into the fabric of the classroom (pre-interview 2nd observation cycle, March 26, 2018). As a management strategy, she found it helpful to have a point of contact in the group and she liked that only one student was allowed to get out of their seat (pre-interview 2nd observation cycle, March 26, 2018). Resource Monitor aligned with the instrumentality of her classroom environment.

But Lee felt that she was missing something or not explaining something correctly when it came to the other roles. "They're not taking ownership, the ultimate goal is to make sure that everybody has some status and is involved - when I observe the groups, that doesn't seem to be happening. It just seems to partition them out" (pre-interview 2nd observation cycle, March 26, 2018). Rather than equalizing participation by alleviating status issues, Lee believed her students were experiencing further fragmentation in the groups when she tried to incorporate the other

roles. Instead of equalizing issues of status, Lee felt the roles as they were being enacted might be reinforcing status differences. Therefore, she made the conscious decision to scale back.

Lee would rather focus on quality, not quantity, by having one role successfully in play and build from there,. She wanted the students to have buy-in and to understand the meaning behind the roles, as opposed to them being something in name only. In a self-bridging move, Lee felt the best way to move her instructional practice closer to an idealized enactment of CI was to pull back on the use of the other roles "cause otherwise they're just learning that it's just a name and it doesn't have a meaning" (pre-interview 2nd observation cycle, March 26, 2018) (see Table 5.1). Once she felt her students had mastered Resource Monitor, she would have more confidence in integrating the additional roles.

Instructional context. As Lee reflected on her second lesson observation, she compared the current task of vacation planning, to the way she might have engaged her students in a task on these mathematical concepts in prior years (working individually on a worksheet of story problems). “The pro to the way I used to do it is initially it's easier. You get nice, tidy papers to turn in. You know, people come in…it's easy, it's familiar, it's routine. You collect the papers and it's done” (post-interview 2nd observation cycle, March 29, 2018). Lee’s more traditional instructional strategies used very few resources, resulted in a high quantity of tangible outputs, and did not cause consternation among her site administration.

However, these instructional strategies conflicted with Lee’s core beliefs about what mathematics teaching and learning should look like and sound like.

> I think it's better this way because they are all engaged in the math…they're definitely talking more about the math and working through more permutations because when there are three other kids in the group people will come up with things that one kid wouldn't

> have thought of so that forces them to think about the math in a different way. So last year I would have tried to have them talking…but it wouldn't have been as rich, I don't think. (post-interview 2nd observation cycle, March 29, 2018)

There was a relatively low cost to maintain the status quo and run a mathematics classroom the *way it should be*, both along the dimension of cost of resources such as time and materials, and along the congruence dimension with the alignment to her educational context. But for Lee, this was too a high a cost in terms of congruence and the currency was her beliefs and perception of herself as a mathematics educator. When two domains in practicality theory conflict, a teacher must make decisions or concessions to bring about an instructional practice that more closely aligns with their beliefs, while bringing more of a balance to the three domains (congruence, instrumentality, & cost).

Regular Practice (as described in initial project interview) Jan 19, 2018	I know sometimes students can be assigned different roles. When left to their own devices in groupwork, I'm not where I want to be in assigning them roles and making sure they're all participating. And I know that Complex Instruction done correctly has kids all participating ideally.
1st Lesson Observation Cycle Pre-interview - Jan 21	Once they get to their groups, we'll review the role cards, …three or four things that I'm really looking for like is everybody participating? Are they sticking to their role cards and not taking other people's roles. Specific mention of Facilitator and Resource Monitor.
1st Lesson Observation Cycle Post-interview - Jan 28	I felt really stuck in getting everybody to participate equally, and I didn't always see how the roles on the role cards assisted in that process.
2nd Lesson Observation Cycle Pre-interview - Mar 26	When I assign the roles, I am not doing it well enough yet for that to get everybody participating. I'm going to have a Resource Monitor, cause that part works well and I have managed to, I think, teach them that role successfully, So, I'll keep that but the others, I haven't yet learned how to make them effective. I'm hoping that that'll become more clear to me, cause I - it wouldn't be in there if it didn't work, but I haven't been successful, yet.
2nd Lesson Observation Cycle Post-interview - Mar 29	They're the Resource Monitor. They understood it, and they knew what their job was.
3rd Lesson Observation Cycle Pre-interview - May 10	I'm still struggling with roles. You know I haven't moved beyond Resource Monitor, and I feel at this point I'm just gonna keep Resource Monitor. I will continue to work on the roles, but I think, at this time of year and at this lesson, that's not where my energy is best spent. I want to focus more on just the making sure they all participate.
3rd Lesson Observation Cycle Post-interview - May 14	I still feel like it was successful in that almost everybody was talking, they were conversing, kids who usually don't work together. I made a chart in my notebook. I was marking who was talking to whom, like I would put the initials and then I'd mark who was working together by arrows and then I would use check marks for when I heard them talking about the math.
Post Project Interview May 21	It also involves protocols for everybody participating and taking turns and there are built in pieces where there's built in steps of interdependence.
Idealized Enactment	"We assign students formal roles, with well-defined duties that draw them into the mathematics at stake in the task" (Featherstone, et al., 2011, p. 42)

Table 5.1. Overview of Lee's Self-Bridging Sequence
Outline of the tweaks to her instructional practice in regards to use of roles

Third Observation Cycle

Task. According to Lee, she experienced increased success in enacting tasks that included the tenants of CI, as she experimented with the structures in not only math, but other content areas. “I'm noticing tremendous progress, talking together and everything else…But during the discussion at least, they were all talking about it… I've seen it transfer into all subjects” (pre-interview 3rd observation cycle, May 10, 2018). Lee’s desire to have her students become more active participants in their learning as well as her desire to refine her own practice led her to expand her focus and apply the ideas across her instructional day.

She continued to write her own tasks, and made small changes as she went along based on lessons learned from previous enactments. Initially Lee honed in on the *complex* part of complex tasks and had created ornate tasks with multiple parts and pieces. By the end of the semester, Lee decided she was "going to try to keep it simple, for once, so I can really focus on the skill and the groupwork" (pre-interview 3rd observation cycle, May 10, 2018). Even with her decision from the onset to keep it simple, Lee found herself revising the task an hour before she gave it to the students, as she realized her initial plan was too much of an overreach for the students (written reflection 3rd observation cycle, May 11, 2018).

For the mathematical content of the task for the third observation, Lee devised some measurement word problems where students would add related fractions with unlike denominators. As a group, the students would need to have at least four solving strategies, and all group members needed to be able to explain each method. "It's not something we've done, and I want to see how they approach it and what kind of problem solving skills they use. So I'm curious to see how they apply what they know about fractions" (pre-interview 3rd observation cycle, May 10, 2018). For her groupwork goal, Lee was still focused on all students being

engaged in the task (pre-interview 3rd observation cycle, May 10, 2018).

Roles became discussion protocols and tracking charts. Lee was able to experience some success in her overall goal of increasing student participation and equalizing status among her students, despite the fact that she had not mastered roles. By the 3rd observation cycle, Lee had not moved past Resource Monitor, and had resigned herself to the idea that "it was as good as it was going to get" for the remainder of the school year (pre-interview 3rd observation cycle, May 10, 2018). However, she was able to incorporate a turn-taking discussion protocol, which provided the students a structure for sharing ideas and questions. Lee gave each group an object, and reminded them that the student who was holding the object was the only one allowed to explain their idea. The students passed the object around the group for the initial sharing, and then the object made a second pass while the students responded to someone else's idea (pre-interview 3rd observation cycle, May 10, 2018).

While Lee noticed the students had in general become better listeners, she admitted that the protocol was not fool-proof, and there was still prevalence for some students to dominate the conversations. However, the turn-taking protocol gave some of the under-participators the opportunity to get a word in edge-wise, as Lee elaborated with the following anecdote.

> There's this girl, Sally, for example, just really quiet, but she's gotten used to the fact that she's gonna be given a chance usually, so she'll sit there, and if I'm observing across the room, she won't be speaking. But if I go to the table, and if I say, ok you know, Max you finished talking, whatever, now pass the whatever to Sally, she's got it and she's ready to speak. So they are the quieter kids. It's not that she doesn't necessarily have status. She just is quieter. But they are starting to get more comfortable with the routine and they are more prepared to speak. (pre-interview 3rd observation cycle, May 10, 2018)

Lee felt this structure helped the students share and listen to one another's contributions.

Lee shifted her focus from roles towards the discussion protocols as a way to include more student voice and address issues of status that were negatively impacting participation (see Table 5.1). For Lee, the abstractness of roles impacted the instrumentality of their application in her classroom. She had previously stated that she felt the procedures around the roles were not outlined clearly and succinctly and therefore she could not convey their purpose adequately to the students (pre-interview 2nd observation cycle, March 26, 2018). ”I'll continue to work on the roles, but I think, at this time of year and at this lesson, that's not where my energy is best spent. I want to focus more on just making sure they all participate" (pre-interview 3rd observation cycle, May 10, 2018). Focusing on the turn-taking discussion protocol was something concrete that Lee was familiar with and believed she and her students could incorporate into their learning environment. The turn-taking discussion protocol was a way to increase participation in an effort to address status issues that were negatively affecting students' access to learning.

Another concrete way Lee was able to monitor the students' participation and engagement was through a tracking chart she devised (see Figure 5.3). "I used a seating chart to keep track of participation and that has helped me think about the lesson afterwards as well as helping me keep track of them in the moment" (post-interview 3rd observation cycle, May 14, 2018). Lee used her chart to record who was talking to whom, who was having mathematical discussions, and where the students were in their understanding of the mathematical content. "I heard them say, 'Can I expand on what you said' or 'I’d like to add on to this', 'Could you explain your thinking', you know like and I was like, 'yes, yes!'" (post-interview 3rd observation cycle, May 14, 2018). Because Lee’s word problem task was more accessible for her students, they did not need her intervention as much and she was able to focus more on their interactions. The

tracking chart was another way Lee modified the instrumentality of student participation to be a concrete procedure that aligned with her existing classroom procedures.

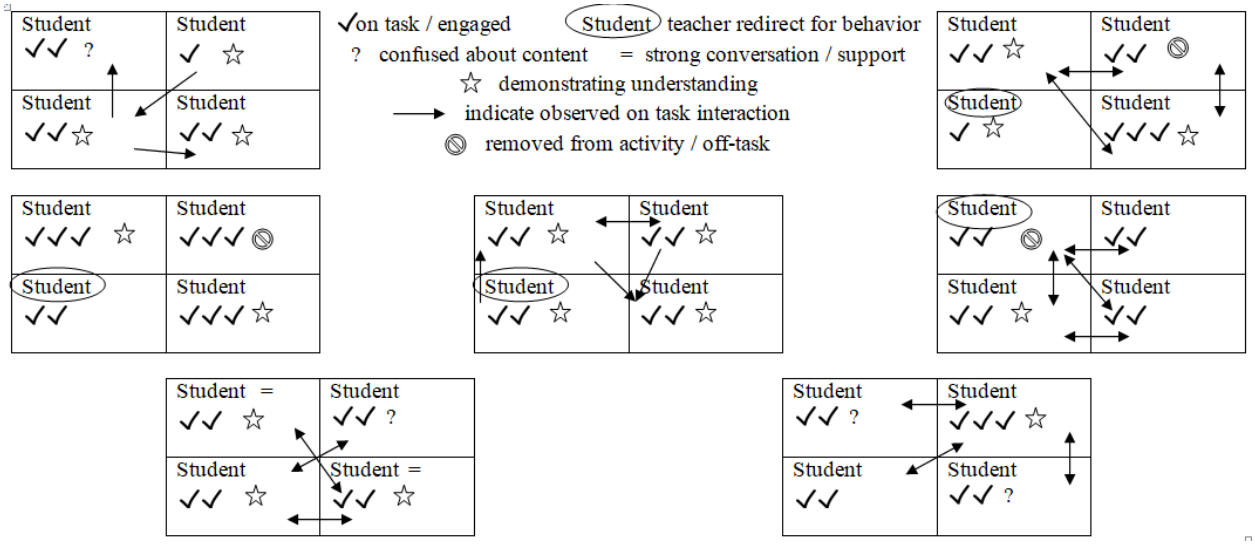


Figure 5.3. Sample Observation Chart.
Sample of how Lee tracked student participation in a task.

Where Lee Ended

Lee's Instructional Context

> Yes. So, it was a CI task, but it wasn't math, but um, the district teams were walking through…A little part of me was nervous just cause I was doing almost no talking for the whole time they were in here, and the old model is so different. But that is my goal. I should have a really strong set up, and I should make sure the task really works. I should be really good at asking questions when they're stuck, or that will help them think it through further, and I need to be really strong in making sure that they're all engaged. (pre-interview 3rd observation cycle, May 10, 2018)

Lee became more confident in her ability to explain how the instructional practice of CI promoted the goals she had set for her students' learning, and felt more able to take on the challenge of explaining that connection to others. "I'm doing this more even if I know people are

coming in, because I feel like I have some proof behind it. And I feel even if they didn't understand it at the time I can explain it later" (post-project interview, May 21, 2018). Through Lee's work and reflection over the course of the semester, she was able to reconcile the misalignment along the congruence dimension between the demands of enacting CI in her classroom and the demands she felt she faced on a day-to-day basis in her classroom, school, and district environments. Despite the fact that she realized that observers still might question her motives, Lee felt confident in the alignment between her implementation of CI and the learning goals she had for her students as learners. "They're closer. They're more aligned. This is a – I still need a lot of practice – a lot of practice – but I feel like this is definitely bringing me closer. So, it's a good fit" (post-project interview, May 21, 2018). In the short span of this study, Lee went from actively avoiding groupwork tasks, in an effort to evade confrontations or confusion with administrators, to featuring a CI task as her observed lesson for her annual evaluation (pre-interview 3rd observation cycle, May 10, 2018). She no longer believed there existed a misalignment in the congruence dimension between CI and the demands of her teaching environment. Lee was confident in her ability to explain away the perception of any such incongruence by a visitor to her classroom.

Status

At the start of the semester, Lee did not have any systems in place to counter the issues of status she noticed among her students. Throughout the semester, as she enacted the components of CI, Lee felt that that the status issues among her students had lessened.

> I feel like it's [CI] helped me do a better job of communicating group expectations in a way that actually affects a positive change instead of just saying, 'Everybody cooperate' and 'Take turns' and then nothing ever – yeah, they didn't know what that meant. Didn't

happen. (post-project interview, May 21, 2019)

While CI did not have the impact she strived for, nor did she feel the change was permanent, Lee did notice a marked difference how students interacted in the small groups (post-project interview, May 21, 2018). Lee felt the discussion protocols that had been put in place helped over- and under-participators alike, and helped alleviate issues of status that might have impacted students' willingness to contribute in meaningful ways. For the over-participators, Lee talked about how the discussion protocol prevented them from being "bossy" and "hijacking" a group conversation (post-project interview, May 21, 2018). At the same time, the protocol ensured that they would have opportunities to speak, so over-participators knew their time was coming (post-project interview, May 21, 2018). For under-participators, the protocols equalized the floor time and provided a structure so there was a routine to how the sharing occurred. All students knew they'd have a chance to be heard as a valuable member of the group. "I'll walk by and hear the, 'Oh well, I'd like to hear your idea. Can you share?' You know, like in – so that's been really nice" (post-project interview, May 21, 2018).

Lee's "Final" Definition of Complex Instruction

At the end of the semester, Lee was asked again her definition of Complex Instruction, and she said the following.

> A group worthy task that engages all participants…equally. Not equally as far as they do the exact same amount of work but that they all have to participate to do well in – no, not just that because that would be divvying it up and so each person does a different part. They all have to participate cooperatively in order to succeed in the task. It's a task that one of them, ideally – sometimes it's kind of hard to – sometimes it's something one can do alone, but ideally it needs to be something that they can't do alone so that they really

> do have to rely on each other. It also involves protocols for everybody participating and taking turns and there are built in pieces where there's built in steps of interdependence. And it brings out – in whatever subject area it brings up the various strengths of the students so that students who are really strong in whatever the area is may see that they're learning from another student in a way they didn't expect. It ideally gives everybody an opportunity to highlight their different strengths and to learn from each other. (post-project interview, May 21, 2018)

Lee's definition of CI became more defined and moved closer to an idealized version of the instructional practice over the course of the semester. Figure 5.4 depicts the idealized version at the top. The bottom left figure depicts where Lee started in her understanding of CI, which is contrasted with Lee's ending definition portrayed on the bottom right.

As she developed tasks during the semester, Lee found a way to balance the mathematical content goals she had for students with the groupwork goals. While Lee did not fully incorporate roles in her classroom structure, she was able to make Resource Monitor work for her and her students in her classroom environment. Norms for doing mathematics in a groupwork structure were reinforced through the discussion protocols that were enacted and through those practices, status issues that were negatively affecting student learning were beginning to be addressed.

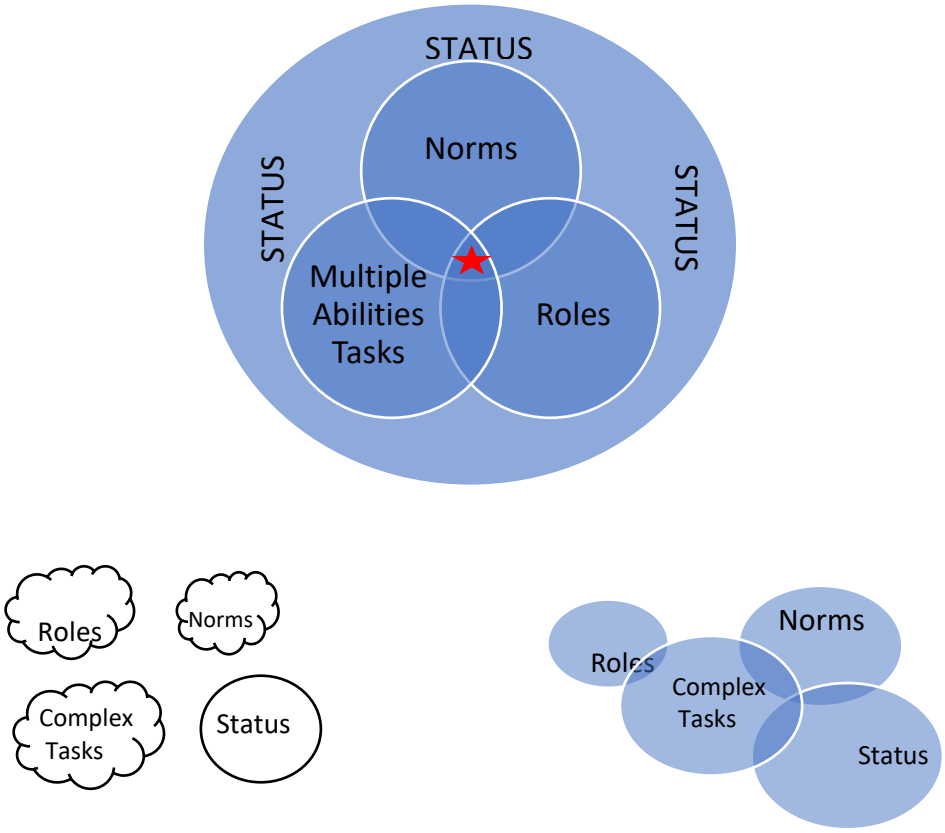


Figure 5.4. Three Definitions of Complex Instruction.
An idealized definition of CI top, center. Lee's starting definition of CI on bottom left and her ending definition on bottom right.

Discussion

The case of Lee helps to further illustrate the powerful influence that the congruence dimension might have on teachers' decision making regarding enacting CI. In the previous story of Meg, we saw how she experienced some struggles along the congruence dimension, but addressed those struggles through attending to the instrumentality of the enactment, which did not result in satisfying results in regards to Meg attaining her instructional goals of attending to status issues to increase student participation. In the case of Lee, we see the opposite phenomena. Lee experienced a similar struggle in terms of enacting roles, but for Lee, the issue could be categorized as one of instrumentality, with her solution being in the congruence dimension.

Instrumentality as the Struggle, Congruence as the Solution

Throughout Lee's story, we saw her grapple with the component of roles. Lee understood that roles were a key way to get students to participate and she desired to balance the inequity of contributions. However, early in the study, Lee struggled with the instrumentality of roles. She could not envision the enactment of the roles in her classroom environment beyond the use of the Resource Monitor. For the remaining roles, Lee was not sure how she could implement them in a way that was effective and more than surface-level.

Contribution to current teaching and learning goals. To address her issue, Lee turned to congruence. She gave herself permission to let the enactment of roles go for the most part, and turned her energies towards her learning goal (i.e. student participation) that could be supported by the roles. In focusing on how she might engage more students in the intellectual conversations around the mathematical tasks through discussion protocols, Lee was able to address a portion of the intention behind student roles. While this did not solve Lee's conflict with roles, it did help move her instructional practices forward in terms of attaining equitable access to the mathematics learning.

The story of Lee shows us an interesting aspect to the self-bridging methodology, as we think about how and why teachers take up instructional practices. There will be components of an innovation that will not immediately work for various reasons. For example, there might exist confusion around procedures or there might be conflicts with one part of an innovation and one's beliefs or goals. In many cases, as we saw with Meg and her use of student roles, the teacher might spend energy towards making components fit into the existing classroom structure. In other cases, such as we saw with Lee, energies might be focused on making the *intention* or the goals of the procedural component fit into the existing classroom structure. As teachers reflect on

their instructional practices and their learning goals, they might sacrifice parts of the innovation for the learning goal. Lee could have continued to work on incorporating student roles into her classroom environment, but she understood that roles, in and of themselves, were not the point. Since Lee understood roles to be a way to increase and equalize student participation, and that was her ultimate goal, she used the alternate procedure of discussion protocols to achieve her goal. As she struggled to equalize student participation through implementing the student roles, she made a conscious decision to not focus as much on the roles and explore other ways that she could attend to increasing student participation. Identifying the instructional goal and keeping that in the forefront might better serve the students in the end, as opposed to forcing a practice that the teacher struggles to incorporate.

Cost & Congruence as Both Struggles and Solutions

Lee also provides us with some richer insights into the overlapping of the dimensions of cost and congruence of practicality theory. Lee expressed a conflict early on between instruction that she believed was best for promoting her students' learning, and practices that she felt was expected by school leadership. There seemed to be a misalignment along the congruence dimension between the way Lee wanted to teach and what she believed were conflicting demands of her teaching environment. While Lee was articulate and knowledgeable about many aspects of teaching and learning, she did not feel comfortable and confident enough with her understanding of CI to justify it as an instructional practice should she be pressed. Therefore, Lee tended to choose the path of least resistance when it came to her instructional practices. This speaks to a negative social cost to enacting CI that existed for Lee.

However, Lee used participation in this study to address the negative social cost. First, it gave Lee an opportunity to use the innovation she wanted to use, as she could blame me for any

deviation from what was expected by classroom visitors, thereby reducing the associated negative social costs. The cost dimension of practicality theory, as you might recall from Chapter 2, not only includes time and materials, but also a social element in the reactions one receives to implementing an innovation. Lee's concern of a perceived negative effect of incorporating CI was replaced by a perceived positive effect in that she was a part of a research study.

Secondly, the regularly scheduled interviews, lesson observations, and amount of reflection time helped Lee develop her understanding of CI in a way that enabled her to clarify the congruence between the innovation and her context. Over a period of five months, I observed Lee's instruction three times and we engaged in eight interviews. In addition, Lee did her own planning and reflecting on the observed lessons, and she also expanded the instructional practices beyond the scope of the lessons I observed. Along the way, Lee was able to formulate her understanding of CI to a degree where she felt comfortable in justifying its use. Lee even featured CI in an observed lesson with her site administrator, which demonstrates how far she had come in addressing the previously perceived misalignment between CI and the existing demands of her teaching environment.

Teachers are often asked to enact instructional practices that they may not fully understand. Or, they might want to enact a practice but not have the confidence to justify its use. They often need to manage multiple innovations, stemming from district, school, and personal initiatives. An understanding of the intentionality and goals behind an innovation can help to clarify its purpose and procedures. In the case of Lee, removing the barrier of social cost allowed her to gain the understanding and confidence to articulate the congruence between the practice and her goals. This rendered the incongruence between the practice and her instructional context defunct. Full understanding of the various instructional practices teachers either choose or are

required to take up can help them see existing alignments between the practices and their contexts. As teachers make these connections, their understanding can grow, and learning goals can be better met.

CHAPTER 6

KAY: A CASE OF NEEDING TO LEARN TO WALK OUR TALK

In this third case, while the theme of CI conflicting with existing demands continues, we will explore the most unique of the three cases in this study. This chapter will tell the story of Kay as she wrestles with conflicting levels of congruence when it comes to implementing Complex Instruction (CI). Kay struggled to make sense of how CI supported what she believed was good mathematics teaching and learning. At the same time, Kay was distracted by competing innovations in her instructional context, which not only included her self-imposed constant state of flux, but (seemingly) conflicting innovations mandated by her school district.

Kay's Initial Definition of Complex Instruction

Norms & Roles

When Kay was asked to define Complex Instruction (CI), the first association she made with the instructional practice was assigned roles. Kay recognized that the purpose of the roles was to "make the playing field for students equal" so that the students would come to understand that all opinions were valued (initial interview, January 6, 2018). Roles helped ensure that no students were overlooked, and that regardless of academic achievements all students could contribute to a task (initial interview, January 6, 2018). In other words, Kay recognized that the intention of the roles was to alleviate disparities of status in the classroom that could hinder access to the learning for all students.

However, Kay did not use the CI roles in her usual classroom routines. Students were encouraged to work collaboratively in pairs or as a group of four, but the structure tended to be free form, initiated with a verbal *Share your ideas* or *Work together* (initial interview, January 6, 2018). Students' place settings were numbered one through four in each group, and that assigned

number occasionally factored in to Kay's instructions. For example, if they were going to work in pairs, Kay might ask all the students with even numbers to start talking first with their odd numbered partner (initial interview, January 6, 2018). It was interesting that despite the lack of use in her classroom environment, Kay mentioned roles before all else. Perhaps the instrumentality of enacting roles in the classroom seemed easy enough, especially given the visual of the role cards. Perhaps there was a perception of very little cost to enacting the roles. In spite of Kay associating CI with roles primarily, they did not factor into her instructional decisions or practices.

Kay only mentioned norms after I asked directly about them. When asked what norms the students followed in her classroom environment, Kay replied,

> Give everyone the chance to participate. Don't start blurting before people are done working. Sit there and wait until I'm like, alright, go ahead and share now. So that whole respecting individual kind of work time. Um - the norms for talking, which we still struggle with is, discussion has to be one person at a time, not everyone just kinda blurting out at the same time. Understanding that people make mistakes and mistakes are how they learn. It's ok. We don't laugh. You, you kind of learn from that. Those would be the major kind of norms. (pre-interview 1st observation cycle, February 26, 2018)

While there was evidence of CI in Kay's description of her classroom norms, such as the space to listen and be heard, and that mistakes were part of the process, there also was an underlying teacher-centeredness. While perhaps well-intentioned, in an effort to ensure the students had the time and space they needed to process, it seemed as though Kay controlled incremental steps in the learning process. For example, students needed her permission to move from quiet think time to small group discussion.

When I inquired if the students knew the norms and if there were structures in place to help them follow the norms, Kay said, "I know I state those things all the time, but I don't have them posted or anything. Which is probably a really good idea. I should start doing that. {laughs} Not tomorrow. But I do need to post those" (pre-interview 1st observation cycle, February 26, 2018). Kay had a clear idea of the ways in which she wanted her students to engage with each other while doing mathematics, but it seemed as though norms for doing mathematics were another component of CI that had no formal structure in place in the classroom environment beyond her own verbal reinforcement.

Tasks

When asked about the tasks in a CI environment, Kay spoke of them, not as a component *of*, but rather as what *was* CI.

> Complex Instruction is rigorous tasks that can be approached from different angles, use multiple math skills, require different types of thinking. Complex Instruction tasks shouldn't be tasks that a person can complete on their own. They should require collaboration between students. I remember, some of them were kinda challenging, but they were fun at the same time. (initial interview, January 6, 2018)

As with norms, Kay had a clear understanding of what constituted a groupworthy task. Her definition was fairly aligned with tasks from an idealized CI enactment, as she included aspects such as addressing multiple intelligences and interdependence among the group members. But for Kay, the task was CI. If students were engaged in a groupworthy task, they were *doing* CI.

Unlike the other two teachers featured in this study, Kay had formal curriculum resources to follow. Her school district provided an online, problem-based curriculum that had been developed by an outside company. Typical her daily instructional sequence included a warm-up

problem, one or two main tasks on the day's conceptual understanding, and a cool-down problem that could be used to formatively assess the students' current level of comprehension (initial interview, January 6, 2018). Because of this required curriculum, Kay did not have the flexibility Meg and Lee had in selecting what lessons I would observe. Her pacing calendar was tight and left little room for deviation. As a consequence, Kay could not choose to teach a lesson that involved a CI task from a workshop on a regular basis.

With that said, the required curriculum supported the idea of mathematics learning as a social activity, and (in my opinion) could easily have been adapted into an environment that was based on and supported the tenets of CI. The majority of tasks were recommended for partners or groups, and encouraged students to share initial thoughts and strategies after a few minutes of individual processing time. Tasks presented to students were designed to build a conceptual understanding, before using that knowledge to move to more procedural algorithms. Nearly every task presented to the students was problem-based, as opposed to more traditional curricular resources that featured repetition of rote calculations. Even though Kay's curriculum could be easily modified into CI tasks, in each of the enactments I saw, Kay tended towards more teacher-centered practices as opposed to student-centered. This will be described in the sections on the observed lessons.

Status

Despite the prevalence of discrete tasks and roles in Kay's initial definition of CI, she was more drawn to the idea of CI as a way for her classroom to be a more inclusive environment for her students. She appreciated that in a classroom where CI was a part of the ecology, students were less likely to look down on their peers who they perceived as less capable, and less likely to perceive others (and themselves) as less capable in the first place (initial interview, January 6,

2018). The concept of *Smarter Together* was important to Kay, and she liked that unique insights to mathematical problems and tasks were encouraged, and that collaboration was a strategy for problem solving (initial interview, January 6, 2018).

However, when I asked Kay if her students labeled each other, if she were to ask her students who was the smartest, she quickly recalled examples of students ranking and sorting their peers and assigning status to each other.

- I'll bet so and so has an A.
- When we're looking at our interim donut and they see that there is one highly proficient student, right away they'll start making guesses about who they think it is.
- If students are working on a problem and I point out I saw a student using this strategy, they right away wanna guess whose strategy it is and then right away go to the students who are higher and stronger in math. (initial interview, January 6, 2018)

Kay was aware that her students attended to status. However, she seemed untroubled by the status issues she identified, as the students seemed focused on identifying students of high status, as opposed to students of low status.

> You know what's really weird as I'm thinking about this. They pick the high students all the time, who they think is the highest, but they'll never say, like when I said ok here's an incorrect answer someone got, they'll never say oh I betcha that's so and so's. Does that make sense? So there more of a, they're guessing to see who's getting the right answers. They don't even worry about whose incorrect answer it is. And I think that comes down to that big, or the stress that's been put on mistakes are good. So I think that is why they

> don't kinda single out the students that are maybe lower in math, because they know that everyone is learning at different rates. (initial interview, January 6, 2018)

Kay was cognizant of her students' perceptions of each other's mathematical abilities. However, since the students focused on identifying correct responders and high achievers, she did not see the practice as particularly harmful to her overall classroom ecology.

When Kay overheard her students trying to identify whose work was being featured she tried to redirect them. "I just say, well this is something we've all become really strong in, it doesn't necessarily mean it's the highest. I pretty much tell it shouldn't matter whose strategy I'm using. It's a different strategy you can use" (initial interview, January 6, 2018). I pressed a little more, asking if she thought students noticed if they were never associated with model work samples or high scores, and if that might be a ranking by omission. Kay believed that that was not an issue since she often sought out work from students at a variety of levels, "from my SPED students to just my average student. So I make sure that they're all given the opportunity to share their knowledge in the class" (initial interview, January 6, 2018). Kay attended to issues of status. However, her focus was on the more overt aspects of status when students sought identification of high status students. As a result, she was not actively noticing or addressing the possible role of status affecting the learning of her "SPED" and "average" students.

Where Kay Started

Kay's definition of CI at the start of the study is depicted by the visual to the right in Figure 6.1. Roles were the first component Kay thought of when it came to CI, however in her description of them, she did not elaborate beyond a one-liner. Because of Kay's lack of clarity in regards to roles, they are shown in a cloud. Kay did relay that roles were a way to address status,

therefore those two components are connected. However, since Kay did not use roles in her instructional practice, they are white.

Kay had a clearer idea about status, in that students could perceive each other as assets in their collaborative work, therefore this component is in a circle. She recognized it was an important part of the CI process, so it has some considerable size. However, since Kay did not seem to be tuned in to the leveled nuance of status in her classroom, this component is white.

Norms were taken as a given for Kay, and she had a clear definition that closely aligned with the intention of CI, therefore norms are depicted in a circle. The importance of norms to the overall process of CI seemed equivalent to that of status, in that they existed, but almost as though they were expected to happen organically. Despite the fact that there were no formal structures in place for students to take ownership of the norms, they were present in Kay's verbal reinforcement from time to time, so norms are blue. Lastly, norms were connected to how students engaged in tasks so that relationship is shown by the overlapping circles.

Somewhat taking over her visual are the tasks themselves. Kay had a very clear definition of what made a mathematical task worthy of being called a CI task, and for Kay, that was what CI was. The task was most important to her definition of the instructional practice. Because Kay had a provided curriculum, with an accompanying pacing calendar, she did not have time to engage her class in tasks she considered CI, and therefore, Kay believed she was not doing CI in her classroom, and the section is not colored in. Despite the fact that Kay knew what each element of CI entailed, CI was not really happening in Kay's classroom. The tenets of CI were not embedded in the fabric of her classroom environment.

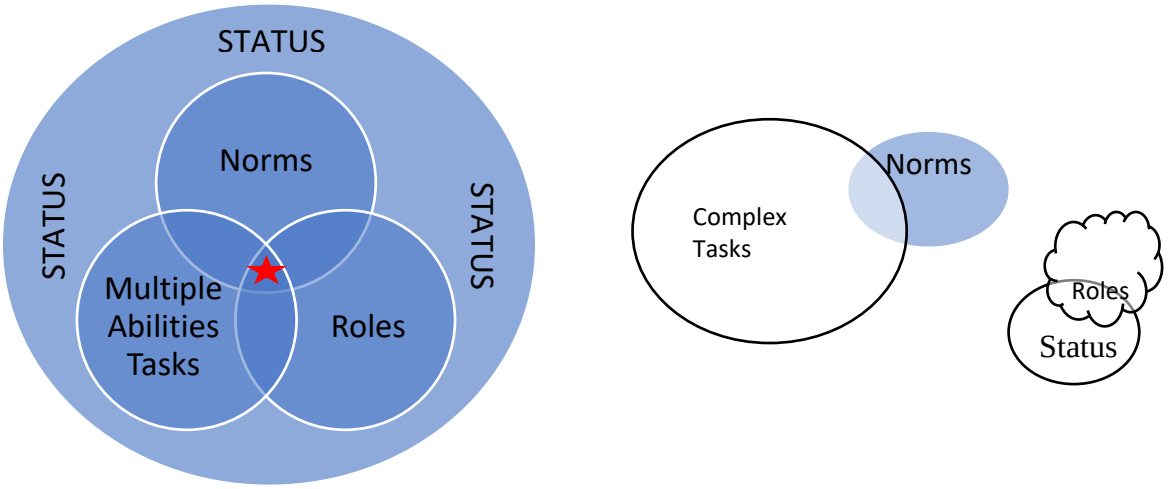


Figure 6.1. Two Definitions of Complex Instruction.
An idealized definition of CI on the left. Kay's initial definition of CI on the right.

Kay had a theory as to why she was not implementing CI. She hypothesized that her mobility from grade level to grade level and school to school might be a barrier to her implementation of this instructional practice.

> I like to jump around, and I like to change, but … it doesn't always allow for me to fully play with what I'm learning. And, I have to juggle, ok I learned this, I believed in it, I think it's really cool. But now I'm learning this new curriculum, these new standards. Alright, this has to go to the side. (initial interview, January 6, 2018)

In this quote, we can analyze Kay's enactment of CI through the lens of all three dimension of practicality theory. Kay's mobility limited her "playing" with the procedures of CI in her new classroom environments (initial interview, January 6, 2018). Because of this, Kay might have had a misalignment along the instrumentality dimension, in that she couldn't clearly envision the procedures of CI in her classroom environment. The cost of enacting CI along with learning new standards and curriculum was too great, in comparison to the expected return on everyday teaching demands. And yet she acknowledged a felt there was congruence between the

innovation and her own teaching beliefs and values (i.e., “I believed in it” (initial interview, January 6, 2018)). The tenets of CI reinforced how Kay saw her students as mathematical learners. As the story of Kay unfolds, a hierarchy among dimensions emerges, and one will win out. And it seems as though, initially, as we saw in the cases of Meg and Lee, the congruence dimension is quite influential on instructional practices.

Bridging Instructional Practices

Next, we will look at Kay's enacted instructional practice as it occurred over the course of this study. Through the lens of practicality theory, we will analyze the factors that improve, maintain, and interfere with Lee's practice in regards to CI.

First Observation Cycle

Anticipated practice. As part of the pre-interview process for each teacher for each of the the three observation cycles, Kay and I co-constructed a Heuristic Goal System Map (HGS) (see Figure 6.2) and did a Teacher Impact Analysis (TIA). While these were helpful planning and analysis tools for all the teachers' observation cycles, I chose to include Kay's HGS for the first observation cycle because I believe it is particularly helpful towards making sense of her instructional practices and goals, as well as the decisions we both made during this lesson cycle. The HGS was based on what Kay was going to do (lesson segments), why she was going to do it (instructional goals), and how she was going to do it (procedural elements). Figure 6.2 represents only a portion of Kay's anticipated practices for the lesson; one of four tasks. Kay's sequence of anticipated instructional practices are along the middle, in blue. The instructional goals are in green, and move from more general to more specific. The logistics of how Kay would prepare for the lesson are along the bottom of the map, in white.

For this particular lesson, Kay identified her mathematical content goal as students being able to solidify the meaning of absolute value within the context of sea level. Her identified mathematical practice goal was for students to justify their reasoning. Her CI goal was for students to work together and discuss the mathematics, but more specifically, for the students to provide self and peer feedback, as opposed to looking to her for redirection or confirmation (pre-interview 1st observation cycle, February 26, 2018).

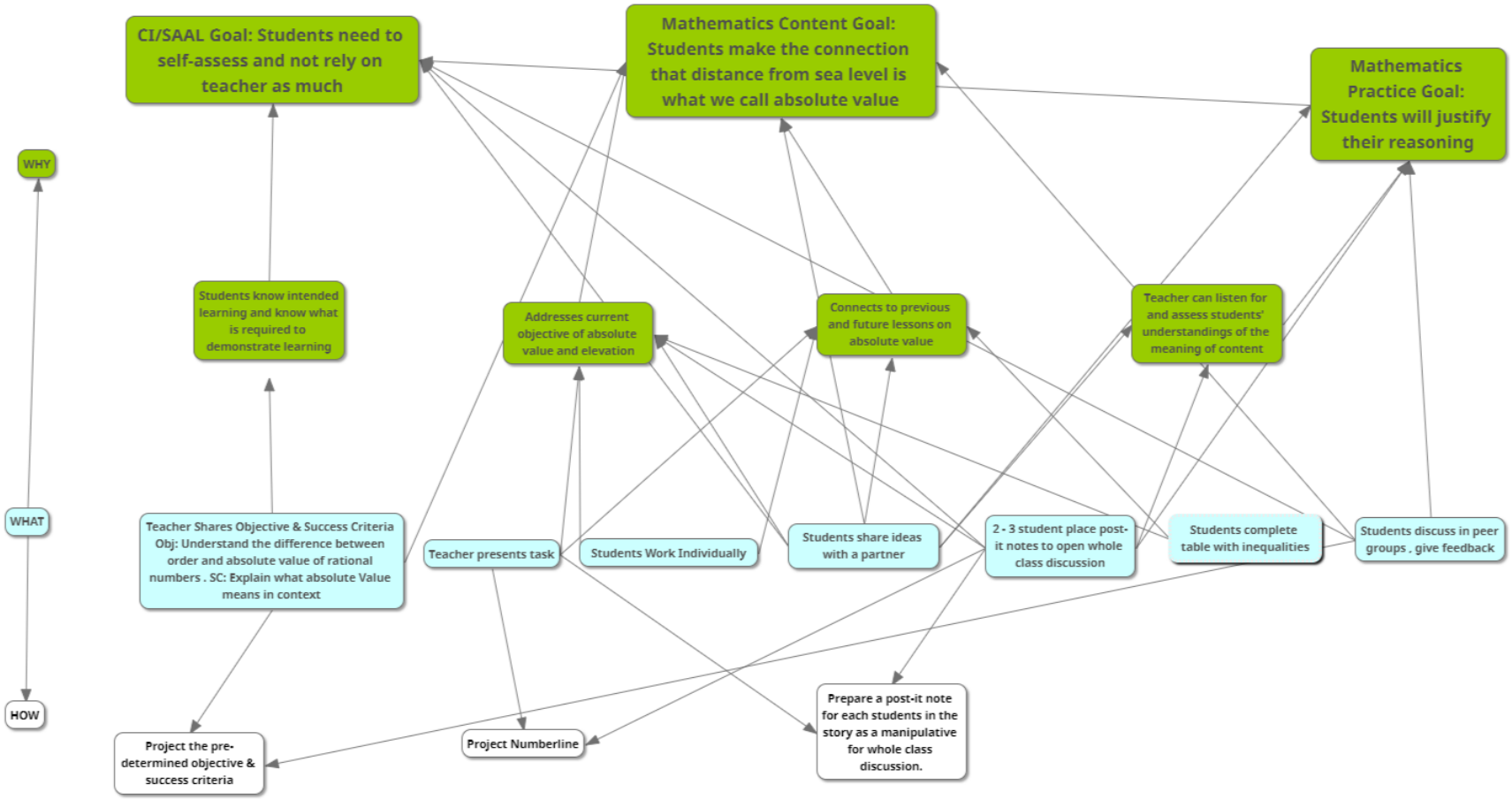
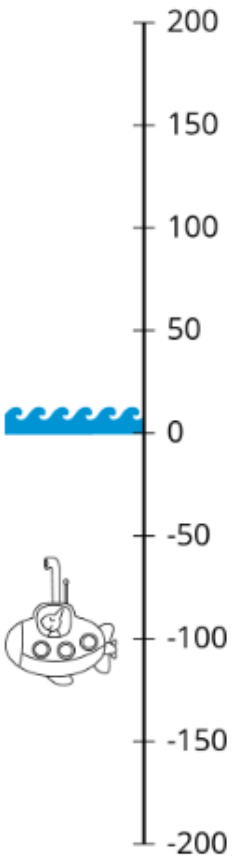


Figure 6.2. Heuristic Goal System (HGS) Map
Kay's anticipated instructional practice for the first lesson observation.

In the day's main task, the Submarine activity (see Figure 6.3), students were to deduce possible elevations of four people based on given clues. Kay would start by sharing the objective and success criteria, as well as launch the task itself. Students would work individually for a few minutes, making sense of the context, and then continue to work in pairs. As a class, they would create a visual of the elevations with sticky notes on a vertical number line, and individually they were to record the information in the provided table. Along the way, Kay wanted the students to give each other feedback on their work (pre-interview 1st observation cycle, February 26, 2018). The Submarine task set students up for the culminating activity, where they were to choose two rational numbers from a set of 15 quantities and write comparison statements (see Figure 6.4).



A submarine is at an elevation of -100 feet (100 feet below sea level). Let's compare the elevations of these four people to that of the submarine:

- Clare's elevation is greater than the elevation of the submarine. Clare is farther from sea level than the submarine.
- Andre's elevation is less than the elevation of the submarine. Andre is farther away from sea level than the submarine.
- Han's elevation is greater than the elevation of the submarine. Han is closer to sea level than is the submarine.
- Lin's elevation is the same distance away from sea level as the submarine's.

1. Complete the table as follows.
   a. Write a possible elevation for each person.
   b. Use $<$, $>$, or $=$ to compare the elevation of that person to that of the submarine.
   c. Use absolute value to tell how far away the person is from sea level (elevation 0).

As an example, the first row has been filled with a possible elevation for Clare.

	possible elevation	compare to submarine	distance from sea level
Clare	150 feet	$150 > -100$	$\|150\|$ or 150 feet
Andre			
Han			
Lin			

Figure 6.3. Submarine Task.
Main task as outlined in provided curriculum for first observation cycle.

Kay stated that the culminating activity in Figure 6.4 most closely resembled a groupworthy task, in that students had choice in which rational numbers they would compare from the provided collection She believed the ability to select values that students felt comfortable with "leveled the playing field" in that it "gave even your quieter, most unsure students opportunities to be somewhat successful" (pre-interview 1st observation cycle, February 26, 2018). Kay made an additional connection between the anticipated observed lesson and CI, in that she felt her students would be deeply engaged in discussions with one another.

Here are some numbers and inequality symbols. Work with your partner to write true comparison statements.

-0.7	$-\frac{3}{5}$	1	4	$\lvert -8 \rvert$	$<$
$-\frac{6}{3}$	-2.5	2.5	8	$\lvert 0.7 \rvert$	$=$
-4	0	$\frac{7}{2}$	$\lvert 3 \rvert$	$\lvert -\frac{5}{2} \rvert$	$>$

One partner should select two numbers and one comparison symbol and use them to write a true statement using symbols. The other partner should write a sentence in words with the same meaning, using the following phrases:

- is equal to
- is the absolute value of
- is greater than
- is less than

For example, one partner could write $4 < 8$ and the other would write, "4 is less than 8." Switch roles until each partner has three true mathematical statements and three sentences written down.

Figure 6.4. Inequality Mix and Match.
Culminating task as outlined in provided curriculum for first observation cycle.

Kay's CI goal stemmed from the idea of discussion. However, her CI goal was influenced by another (seemingly competing) innovation in which she was engaged. As a Lead Teacher,

Kay was enrolled in an online course on student agency in assessment and learning (SAAL). The goals of SAAL were for students to become active agents in their own learning and assessment which included students setting their personal learning goals, students actively monitoring their learning and generating personal feedback that they act on, students communicating feedback to their peers, and students using feedback from their teacher and peers to make decisions about their own learning (SAAL project overview).

Much like Kay had stated previously, that CI had been abandoned while she focused on learning standards and curriculum for new grade levels, this theme recurred in regards to the work she was doing around SAAL. Because Kay was focused on SAAL and its tenets, much of our conversation around CI seemed to be diverted back to SAAL. However, the two innovations, CI and SAAL, were not conflicting and even could have reinforced one another. For example, one of Kay's learning goals was for students to work together and discuss the mathematics; goals that reflected CI and SAAL. One might argue that norms and roles that addressed issues of status might need to be established to create the space for the student discussions and for honest feedback. Students who did not see their peers as having valuable mathematical contributions might not take heed of any provided feedback. So, by attending to the tenets of CI, Kay would also be attending to the tenets of SAAL. But, for Kay, there was a clear distinction between the two instructional practices, and she only had room to focus on one at a time. Since SAAL was being mandated as her role as a Teacher Leader, it took precedence. Kay perceived a misalignment along the congruence dimension between enacting CI and the existing demands of SAAL in her teaching environment.

Kay went on to define the particular content of the discussions she would listen for. "I might hear, 'I agree' [from a student] and so my question [to the student] would be 'so like tell

me, explain to me exactly why do you agree. How do you both know you're correct'" (pre-interview 1st observation cycle, February 26, 2018). There is something else of interest to note in this example. Kay stated that she ultimately wanted the students to provide self and peer feedback, as opposed to looking to her for redirection or confirmation (pre-interview 1st observation cycle, February 26, 2018). And yet, in her example of how that feedback might occur, she modeled interjecting into the students' process and asked the students to explain themselves to her. Kay featured her own questioning as opposed to what it might sound like if the students elaborated on their thinking or probed their peers' justifications. This might speak to a misalignment along the instrumentality dimension, in that it might have been difficult for Kay to even envision what an exchange between just the students would look like, and therefore would make enacting the practice that much more difficult.

Enactment 1. Kay began the lesson segment by having students make sense of the information provided in the Submarine task. She asked questions about what a submarine was, what the 0 on the number line denoted, and if the number line was conveying elevation or temperature. Kay directed the students' attention to the projected copy of the number line, and asked the students if the submarine was at the correct elevation based on the provided information. She then said,

> So now, you’re gonna put each of those people at an elevation in relation to the hints it gives you about the submarine. There’s multiple answers, so don’t think you have to have the same answer as your teammates. And I’m actually going to give you some independent time, and I want us to start with Claire. Let’s look at Claire, which they did for us. (observed lesson 1st observation cycle, February 27, 2018)

The next ten minutes was spent discussing Claire's given elevation and establishing that it was in fact correct. Kay placed a post-it at the 150 mark on the projected number line to note Claire's elevation. Kay asked questions such as "How do we know that 150 is greater than -100?", "Is -100 above or below sea level?", "Is 150 above or below sea level?", and "So what is the absolute value of 150 according to the table?" (observed lesson 1st observation cycle, February 27, 2018). During this ten minutes of the lesson segment, students were given two minutes to talk in their teams and explain to each other how they knew 150 was greater than -100, but the remainder of the discussion on Claire was whole group, with Kay asking questions and single students responding (observed lesson 1st observation cycle, February 27, 2018).

Kay then had the students move on to Andre in the problem. She spent two minutes reading aloud the clues about Andre twice, directing students to the clue and chart on their paper, and clarified the structure for their group conversation. "Talk in your groups. But this time, I want person number 2 in each group to start talking, then person 3, then 4. Number 1 will be the last person talking" (observed lesson 1st observation cycle, February 27, 2018). Students discussed in small groups for four minutes while Kay walked around, and checked in with two groups. She redirected students, clarified instructions, and asked similar questions as listed before (observed lesson 1st observation cycle, February 27, 2018).

Three minutes was spent in whole group discussion regarding Andre's elevation. Four students were called on, and gave their elevations for Andre of -180 ft., -170 ft., -160 ft., and -150 ft. Kay asked the class how many students had put Andre at -150, and at the revelation that most students had placed Andre there, Kay added a post-it to the projected chart at -150 ft. She read the clues for Andre again and asked the students, "Are all 3 of these elevations farther away from sea level than this? Yes or no?" (observed lesson 1st observation cycle, February 27, 2018).

When they replied yes, she then referred them to the table and asked them to write the distance in absolute value notation.

Kay then directed the students "Go ahead, you guys that are done, go to Han. Read Hans's clues and try to figure out where would you put Han" (observed lesson 1st observation cycle, February 27, 2018). After nine minutes, she called the class together again stating she wanted the class to share. They spent four minutes in whole class discussion. A student shared that they placed Han at 50 ft., and Kay had them come draw a star on the projected number line on the whiteboard. Kay had another student read aloud Han's clues, and had the class verify that the suggested elevation fit both clues. Kay asked the class if that was the only possible elevation for Han, and when they said no, she had another student come draw a star where they had placed Han, at -50 ft. Kay again clarified with the class that this was correct by asking, "Is -50 higher than the submarine? Is it closer to sea level than the submarine?" (observed lesson 1st observation cycle, February 27, 2018).

Kay then told the students, "If you haven't already finished Lin's and talked about it, talk about it now", and she continued to check in with groups, probing in a way similar to what was modeled with the whole group discussion (observed lesson 1st observation cycle, February 27, 2018). After four minutes, she called for the class's attention.

> I talked to a few groups, and so I have a question about Lin's elevation. So, we already discussed, Claire had multiple correct answers. Andre's answers - there is more than one right answer. For Han, there was more than one right answer. My question is, for Lin's elevation, is there more than one possible right answer? How many of you say no, there's not? How many of you say, yes there is more than one possible right answer? (observed lesson 1st observation cycle, February 27, 2018)

One student responded "no" to Kay's inquiry regarding if there was more than one correct elevation for Lin. When Kay asked how many students said "no" and how many students said "yes" a couple hands went up each time. The rest of the students sat still (observed lesson 1st observation cycle, February 27, 2018).

Kay asked a student to explain their reasoning as to why they raised their hand in agreement that Lin had more than one possible elevation. The student provided a fairly thorough justification. Kay had the student repeat their justification after asking the rest of the class to really listen to what was being said. She then asked them to talk in their teams for one minute about what the student shared. When Kay called them back to the whole group discussion, she started with "What Luke said is true. There are two possible right answers" (observed lesson 1st observation cycle, February 27, 2018). While Kay talked, four students had their hands raised in the air. Kay went on, "And I would agree, because there was nothing in that clue that said it can't be -100 ft." (observed lesson 1st observation cycle, February 27, 2018). As Kay talked, the students who had their hands raised lowered them.

Kay's alarm went off, signaling there was ten minutes left before lunch, and Kay stated she wanted the students to start the next activity. The class had spent 45 minutes on the submarine activity.

Throughout Kay's first lesson enactment, I struggled. And while this is not my story, but rather Kay's, my struggles were related to her stated beliefs about teaching and learning mathematics, as well as the goals she had outlined for this lesson. Kay claimed in the initial interview that that one of the greatest ways she could impact her students' learning of mathematics was by allowing them to publically share their strategies and understandings. Kay felt that students understood better when their peers explained mathematical concepts as opposed

to when she did. She had witnessed many a light bulb go off in the "simpler, straight to the point way" when students would convey their ideas to their peers (initial interview, January 6, 2018). This led to Kay to set the goal of student justification for this lesson (pre-interview 1st observation cycle, February 26, 2018). And yet, as I observed this first lesson, I concluded that much of the explanation was coming from Kay, as she brought the students into whole group discussion after each chunk of the task.

Another of Kay's beliefs was that good mathematics teaching allowed students to struggle and become more independent. She wanted students to be self-reliant in thinking through a problem, using readily available resources, such as notes, peers, or prior learned strategies (initial interview, January 6, 2018). This fed into the goal Kay identified for her students to provide feedback to each other and to not rely on her as much to drive the learning (pre-interview 1st observation cycle, February 26, 2018). And yet, the way Kay structured the task she undermined opportunities for student feedback. She took an intriguing problem, and chunked it up, releasing the students to work on only one part at a time. Then they would circle back for whole group, teacher-directed discussion so that Kay could ensure they were on the right track. It seemed as though struggle was fine, but in small doses.

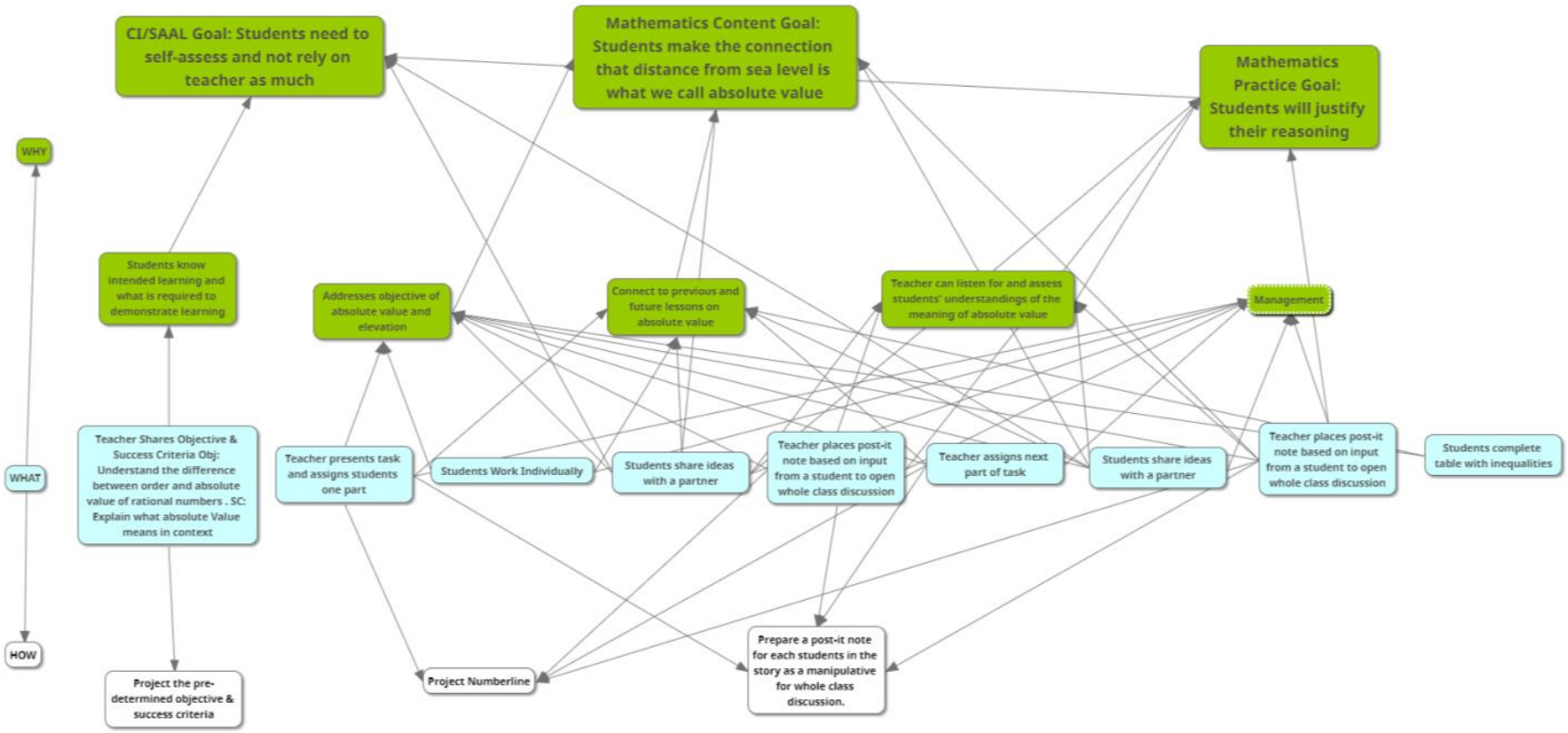


Figure 6.5. Heuristic Goal System (HGS) Map
Kay's enacted instructional practice for the first lesson observation.

The enacted lesson, as depicted in Figure 6.5, while not veering wildly from what was intended, was modified enough that we see an increase in connections between the teacher's chosen actions and the teacher-driven goals. Rather than having students engage with the Submarine Task in its entirety, and then bring them together to discuss understandings and clarify misconceptions, Kay had the students work on each character in isolation. After some work time, she brought them together to discuss the post-it placement to represent the reasonable elevation given the clues, and had them fill in their table (observed lesson 1st observation cycle, February 27, 2018).

Kay stated she wanted her students to self and peer assess, and rely on her as little as possible, however through her enacted instructional practice, she situated herself in the center of the learning as opposed to placing the students at the center. While Kay's enacted structure did provide the benefit of being able to listen to student conversation and informally assess their understanding, she was limited to one group of students at a time or one student who shared aloud. These practices also limited the opportunities students had for peer interactions when they might have provided feedback to one another.

Another interesting side effect of the changes between the intended lesson and the first enactment of the lesson was the unveiling of a previously unidentified goal. Upon reflection, when asked about her reasoning behind structuring the task in chunks and doling them out to the students one at a time, Kay responded "Classroom management. On-task. Not messing around. Increasing overall number of students being productive" (post-interview 1st observation cycle, February 28, 2018). Management, while no doubt takes up permanent residence in the back of most teachers' minds, had not been uttered up until this point. Nor was the class observed to be

particularly unruly or unfocused. And yet in the moment, Kay added an extra layer to the tasks to meet a management goal.

As I observed the lesson, I couldn't help but think that Kay was not meeting the goals she had set for her students during the pre-interview. I wondered what Kay thought of the lesson enactment in terms of meeting her identified goals. I had short bursts of insight of a few small tweaks that would CI-ify the lesson and environment, to open up the opportunity for Kay and her students to attain the goals she had set. Kay taught a second period of mathematics after the lunch break. I devised a quick plan that would break my own study protocols.

Co-Bridging. Practicality theory posits that teachers make judgments about the value of innovations, and specifically in terms of how the innovation positively affects their instructional goals. I asked Kay how she felt she did on attaining the goals she had set forth during our pre-interview for this lesson (mid-reflection interview 1st observation cycle, February 27, 2018). I thought if Kay felt that she attained her goals through her lesson enactment, that I would let it go. If she attained her goals, there would be no reason for her to want to take up CI or any changes to her lesson enactment. However, if she felt that she did not reach the goals she had set to a level of satisfaction, I would suggest the few tweaks that would CI-ify the lesson, to be enacted in the next class period, in an effort to bring her goals closer to realization.

In regards to her math content goal, of students being able to solidify the meaning of absolute value, Kay stated that about 50% of the students met that goal. For her mathematics practice goal of students justifying their reasoning, Kay said that some groups were more self-sufficient than others, and she was prompting students if she didn't hear explanations as she was monitoring the conversations. For the CI goal of having students work together, discuss the mathematics, provide each other feedback and not rely on her quite so much, Kay was very quick

to reply that "no" that goal had not been met (mid-reflection interview 1st observation cycle, February 27, 2018). I had my in.

I proposed for the next class that she present the students with the entire Submarine task at once, and not break it down character by character (mid-reflection interview 1st observation cycle, February 27, 2018). This would increase the students' level of struggle, as chunking the problem might be over-scaffolding and lowering the rigor. By providing the students the entire task up front, students would need to rely on their teammates more and on Kay less thereby removing from the center of the instructional cycle.

I also suggested that in the student groups of four, she assign each student one character from the Submarine problem. That student would be responsible for facilitating the conversation about that character and that would help to equalize the participation among the over- and under-participators (mid-reflection interview 1st observation cycle, February 27, 2018).

Lastly, I suggested that she give each group the different color post-its as opposed to only using one set and she being the only one to manipulate them (mid-reflection interview 1st observation cycle, February 27, 2018). This served several purposes. One, it made the student learning extremely visible. During the first enactment, as Kay was facilitating the conversation, only one or two students chimed in at a time, so while we knew what that student understood, there were 28 students in the class. Giving each group the colored post-its would highlight similarities and anomalies of the groups' understandings immediately and could help steer the conversation. Two, it helped to remove Kay as the driver of the learning. When there was only one set of post-it's and she was the one manipulating them, she was the one with the most direct access to the learning. Additionally, the situation forced the students to rely on her. If each group added their post-its to the graphic, there could be an increased sense of ownership to the learning,

as the students were more invested in the conversation. This opened up more opportunities for students to justify their reasoning and provide feedback to their peers, as their peers' thinking was more accessible. Kay was amenable to these suggestions, and we settled in for round two.

Enactment 2. Kay began the second lesson enactment by telling the class that they would work on the Submarine problem "as a team. Team work meaning cooperating. No one's done till everyone's done..." (observed lesson 1st observation cycle, February 27, 2018). She invited the students to make sense of the projected number line, and asked them to think about what the numbers represented. She gave the students about 30 seconds to discuss their thoughts in their small groups and then pulled them together to give the directions for task completion.

> Person #1 is in charge of reading this information about Claire. Person #2 is in charge of reading and guiding the discussion for their team about Andre. Person #3 is Han. Person #4 is Lin. That means if I am assigned to Claire, when my team starts talking about Claire, I'm gonna be the one that guides the discussion as we all work on kinda solving this problem. People might have different ideas, which is wonderful, and you want to share those ideas, so as a group, you guys can come to a consensus. (observed lesson 1st observation cycle, February 27, 2018)

Kay had the students look at their assigned clue for about a minute, and then she clarified again that they were to come to a group consensus about each character from the problem.

The students worked in their groups for about eight minutes while Kay circulated, redirected, and asked questions about the groups' thinking. Kay announced to the class that she was giving each group four color post-it's, one to represent each character from the problem, and that the groups should be coming close to a consensus on the characters' elevations. About five minutes later, she asked that a member of each group place the groups' post-it's on the projected

number line, and two minutes later, Kay began the whole group discussion (observed lesson 1st observation cycle, February 27, 2018).

Kay asked the students to look at the image they had collectively created, asked what they noticed, and if they had any questions. A couple students stated a few post-it's were not placed correctly on the number line, based on the written elevations. Another student noticed that there was one post-it for Andre (in purple) that was not located where the rest of the purple post-it's were. After the general noticing and wondering, Kay steered the discussion to focus on Claire specifically, and as a class, they spent the next ten minutes on her (observed lesson 1st observation cycle, February 27, 2018).

Kay brought up the question of what greater meant in the context of elevation, stating that was a discussion she had overheard as she visited the groups. Once a student said greater in this context meant a higher elevation than that of the submarine, Kay directed the students to think about the second clue, and then use the two clues to evaluate what they were seeing in terms of Claire's placement on the class visual. "Alright, talk with your teams. Where do you think Claire should be? Should she be closer to sea level or farther from sea level? Should she be above sea level? Should she be below? What do you guys think?" (observed lesson 1st observation cycle, February 27, 2018). Kay had the students look at the given elevation for Claire in the table and notice that it was a positive number. She then asked them to think about that along with the class visual, that had five yellow post-it's at 150 ft, one at -125 ft, and one each at -150 ft and -200 ft. She prompted them to discuss if the possibilities that were represented on the visual but not on the table could be right or wrong, and to discuss why. To assist the students who were not convinced that the suggested negative numbers were not greater than the elevation of the submarine at -100 ft, Kay asked the students to imagine that the vertical number line be rotated

90 degrees clockwise, and then think about if they would move left or right to show greater values. Once the class came to a consensus that the suggested negative values did not fit the clues, Kay moved to Andre's clues (observed lesson 1st observation cycle, February 27, 2018).

For the next five minutes, Kay asked the class questions about whether the suggested elevations were "all possible correct answers or is there something wrong?" (observed lesson 1st observation cycle, February 27, 2018). She focused on the -150 ft. first, and had students tell her why it might be a possibility, what an expression might be to compare the submarine's elevation to Andre's, and clarified again that a greater elevation would be further up on the number line. Kay broached the idea that -200 ft could also be a possibility, after the class confirmed that -150 ft was a correct answer, even though no group had placed a post-it there. Kay asked if 50 ft. was less than -100 ft, and the students said no. She asked if that could be a possibility, and they said no, so she removed that post-it and put it off to the side (observed lesson 1st observation cycle, February 27, 2018).

In the remaining five minutes of class, Kay facilitated the conversation around the proposed elevations for Han and Lin. After some team talk time, the class quickly agreed that -50 ft and 50 ft. satisfied the given clues for Han, and -100 ft and 100 ft were both appropriate for Lin. Kay probed into their reasoning, asking individual students to share what the group had discussed and why both proposed elevations could be correct given the clues (observed lesson 1st observation cycle, February 27, 2018).

While students were discussing the two proposed elevations for Lin, Kay came up to me and said "I failed at this. My goal was to reduce the amount of time" (observed lesson 1st observation cycle, February 27, 2018). I asked, "Why did we make these shifts" (observed lesson 1st observation cycle, February 27, 2018). Kay replied, "To incorporate more CI and put more of

the work on them, not on me. But, I feel the discussion part has taken a little bit longer" (observed lesson 1st observation cycle, February 27, 2018). I said we could discuss her thoughts further during our debrief. The class had spent 54 minutes on the submarine activity.

Throughout this lesson enactment, I did not struggle as much - again, I know it's not about me. The HGS Map in Figure 6.6 shows the connections between the lesson segments of the second enactment (the what) and the goals (the why). In this figure, we see the balance restored between Kay's second lesson enactment and her identified goals. The imbalance that occurred in the first enactment between Kay's intention of having students be self-reliant and the actuality of her positioned in the center of the instruction was corrected by the restructuring of the task.

Additionally, the goal of management, while no doubt ever present, faded back into the subconscious and was no longer explicitly called out. When I asked Kay if she felt that the students in the first enactment were more productive than the students in the second enactment, she settled on "probably not" (post-interview 1st observation cycle, February 28, 2018). Kay admitted that "more students were on task during the second enactment, because they knew they had to work as a team" (post-interview 1st observation cycle, February 28, 2018). Through the structure of the task, and in keeping her goals forefront, Kay was able to inadvertently attend to the sub-goal of management without sacrificing the focus on her main learning goals.

From Kay's own written reflection the day of the two lessons, she said the following of the second lesson enactment:

> As I reflect on both enactments, I realize how scaffolded I made the Submarine Activity for this [first] group. Treating Activity 7.2 as a task [for the second group] put more work on the students. Forced students to use their peers to clarify questions, tasks, thoughts.

> The fact that teams had to come to an agreement on the elevation that they would assign to each person, pushed students to participate. I heard quite a few groups asking their group members what they thought and what possible answers they might have come up with. I was pleasantly surprised in the second enactment at how students self-corrected as they went back to the prompts to justify their answers. It seemed that I was better able to move around to each group and ask clarifying questions (touched base with more groups). The use of color coded sticky notes, made it easier for students to notice patterns in answers they came up with and allowed for discussion on accuracy of their answers. (written reflection 1st observation cycle, February 27, 2018)

In terms of meeting her identified goals, specifically the one about students providing feedback, Kay felt the second enactment better served that purpose, in that the task was more student-driven and opened up the opportunity for them to discuss their thinking. However, in our post interview about the two enactments, Kay wrestled with what she placed a higher premium on - quality or quantity. Kay felt that both enactments had an equal amount of student contributions. While she acknowledged that the quality of conversation from the second enactment was more beneficial to the advancement of the students' understanding, and lent itself to all of her identified goals, she struggled with the idea that the second class didn't complete as much mathematics as the first class (post-interview 1st observation cycle, February 28, 2018). Because the first enactment was teacher-driven, Kay was better able to control the pace and they got further along in the lesson. In the second enactment, because students were driving the conversations, and there were many more student ideas on the table to work through. The conversations took longer and negatively impacted the ability to move on. For Kay, the number of tasks completed was enticing as proof of concept for her mathematical content goal.

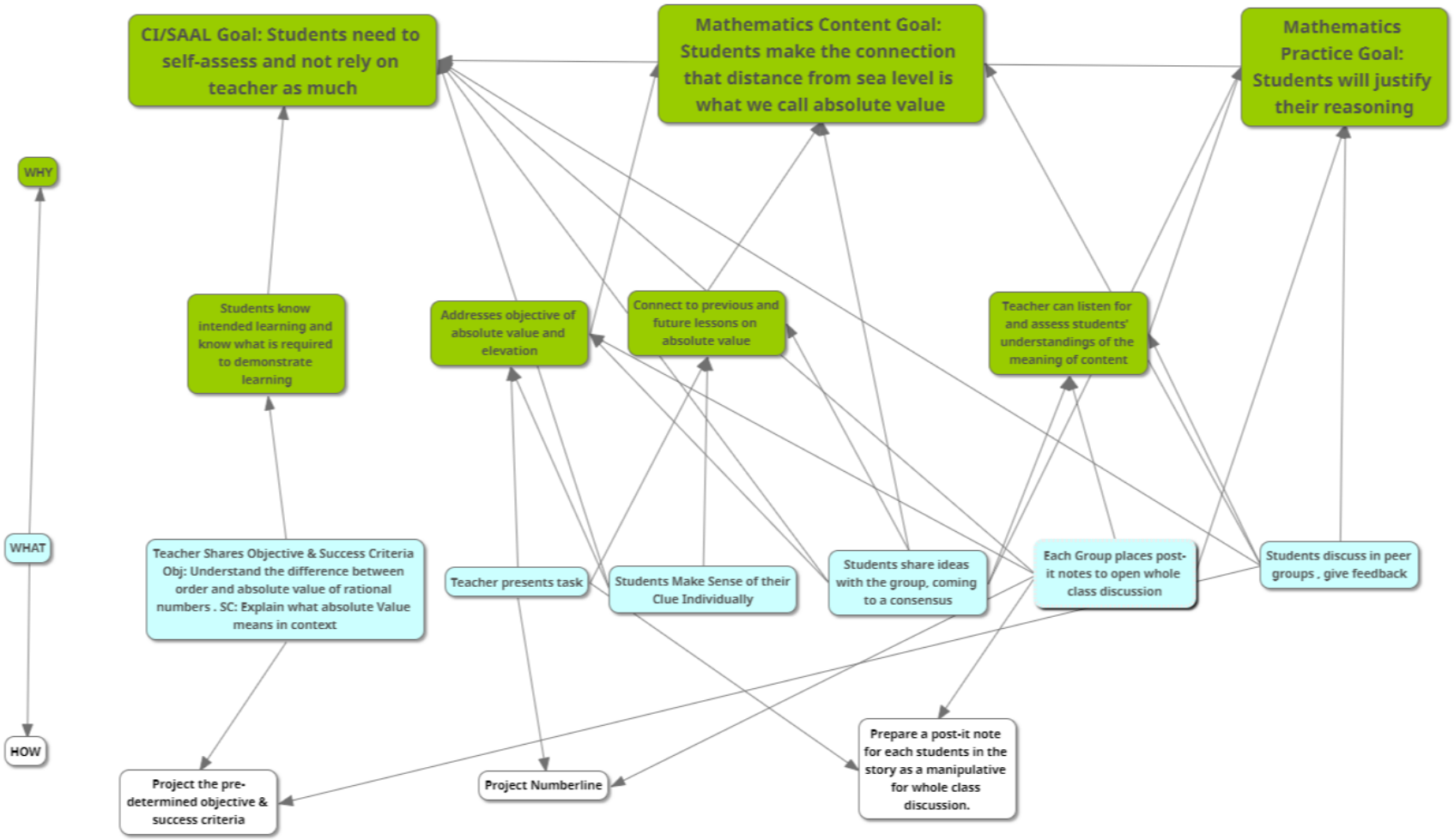


Figure 6.6. Heuristic Goal System (HGS) Map
Kay's anticipated/enacted instructional practice for the first lesson observation, second attempt.

Will the Real Instructional Goal Please Stand Up?

While all the teachers in the study identified several learning goals for each lesson, which for the most part could be neatly categorized into mathematical content goals, mathematical practices goals, and groupwork goals, for Kay, there seemed to be an internal battle between which of the goals were most important. Kay anticipated an intense focus on how students interacted in their groups, and specifically, how they provided feedback to one another. However, what was enacted throughout the semester seemed to directly support Kay's mathematical content goals – to cover the content required by the pacing guide. To do this, she focused on how much mathematics the students actually completed, defining a content focus for student feedback, and a teacher-centeredness that helped to ensure students would not veer too far from the content goal.

Quantity vs. quality. The idea of "completion" and "quantity" from the first lesson observation cycle came up again during our pre-interview for the second lesson observation cycle (not to be confused with the second enactment during the first lesson observation cycle). As Kay outlined what she and the students would do, she expressed concern that there wasn't enough practice for the students to fully understand the concepts (pre-interview 2nd observation cycle, May 9, 2018). At a certain point, she anticipated that some students might finish the task sooner than others, so Kay contemplated have some additional problems prepared for them to work on while the "struggling" students kept working (pre-interview 2nd observation cycle, May 9, 2018). I probed this idea, asking "So you're saying that as students finish early, you're going to give them more practice problems, because you're concerned that they won't have enough practice to understand? But you're gonna give it to the early finishers?" (pre-interview 2nd observation cycle, May 9, 2018).

Kay's reply was

> That's true. Okay, I won't. Like I know which kids are gonna get this, and unfortunately they're not all together; they're in these groups where most of them have one person, at least, that will be sitting there with the deer in the headlight, kind of, but it would be that person that would need the more practice, not my quick finishers. (pre-interview 2nd observation cycle, May 9, 2018)

The contrast between the idea of individual mastery and Kay's previously stated beliefs about teaching and learning mathematics was striking. She stated during the initial project interview that she believed students should work collaboratively in an effort to advance each other's understanding, and yet she referred to instructional practices during the second observation cycle that told a different story. There was a cost to students working collaboratively, and that was the amount of mathematical problems that might be completed by the students. It seemed as though working collaboratively was not as central to the classroom environment as Kay had previously indicated.

Kay stated that she wanted her students to work together, but she balked against many of the structures that would assist the students along the way. While the student roles were the first thing Kay mentioned in her definition of CI, and while she admittedly "saw the point" of the roles, Kay wondered if it would work just as well if you gave the students freedom from the roles but taught them that they had to hold each other accountable (post-interview 2nd observation cycle, May 12, 2018). "We're training them to say, 'Okay. What are your thoughts? You explain this' without having them 'I'm the facilitator. I'm the questioner'. You know what I mean?" (post-interview 2nd observation cycle, May 12, 2018). Kay felt the roles were incongruent with her teaching style and she was unable to see how they aided her in attaining her learning goals. "It's

not that I'm refusing to do it. It's just I don't know if it doesn't go with my style or I'm just being close-minded to it" (post-interview 2nd observation cycle, May 12, 2018). Kay's comment was reminiscent of the incongruence Meg experienced with the roles, and the idea that the roles did not align with who they saw themselves as educators.

And yet, in wanting to have freedom from particular structures, Kay continued to struggle with how to get all students engaged. "But again, I kinda, as I was going through this struggling, like how am I gonna make sure that my more confident students don't overtake conversations" (pre-interview 3rd observation cycle, May 14, 2018). While Kay wanted the outcomes roles might provide, she did not want to actually enact them. There continued to be a misalignment in the instrumentality, congruence, and cost of enacting the roles in her classroom. She could not envision their use, and did not want to have to go through the process of establishing them. Kay wasn't sure they aligned with her teaching personality, but yet she wanted the benefits they provided. By emphasizing the amount of mathematics problems students completed, and by not having structures in place that supported students in communicating with one another, Kay's instructional decisions did not seem to support her groupwork goals.

Teacher-centeredness. During the pre-interview for the second lesson observation cycle Kay identified the following learning goals as works in progress on her HGS map through the TIA; use corresponding parts of figures to explain how a scale factor relates to a figure and it's scaled copy (mathematical content), increase mathematical reasoning and understanding (mathematical practice), as well as increasing the willingness for students to explain and discuss mathematical ideas (groupwork) (pre-interview 2nd observation cycle, May 9, 2018). However, forefront in Kay's mind, based on what she said throughout the semester, was the goal of improving students' self and peer assessment skills, as it related to SAAL. "Well, one of my

goals, and as painful as it is, is to push 'em to self-assess. No matter how raw it is" (pre-interview 3rd observation cycle, May 14, 2018). Kay's language choice in this statement is interesting; painful, push, raw. I wondered from whose perspective she was referring, herself or the students.

When asked how or if there was a component of CI that could help her achieve her instructional goal of students providing self & peer assessment, Kay referred back to the idea of group discussions. "So hearing it within their team, maybe the way their teammates explain it, it sinks in" (pre-interview 2nd observation cycle, May 9, 2018). Kay felt that if students were sharing their thinking in a group, they would be better able to provide feedback to each other on their understanding, as well as to self-assess where they were on the learning continuum.

However, as she continued to outline her anticipated instructional practices, I was reminded of an exchange from the first lesson observation cycle where Kay modeled student conversation, but she was predominately featured.

> Well, the students do a lot of turn and talk, we do whole group instruction. If I see a student struggling, or I see a common mistake, I won't call out the student, but I'll pull up, 'Okay, you guys, this is what I'm seeing right now. Let's talk about this.' Where the person doesn't necessarily have the wrong answer, maybe they just don't have the complete answer. So where then as a group the students chime in and kind of share next steps, or maybe a mistake or a forgotten step, which then allows me to have the students, 'Okay, go back if you're at this point, go back and relook at your work now', which builds the confidence, makes the safe place. (pre-interview 2nd observation cycle, May 9, 2018)

I wondered if Kay was unintentionally undermining her learning goals. In what she described students were not necessarily given the freedom to struggle. Kay acted as assessor as opposed to allowing the students to take control of that process. While it was great she was not necessarily

calling out a particular student, identifying them as the originator of an incorrect idea, she also was not allowing the students to wrestle with their own ideas for too long if it meant them getting off on the wrong track. "I guess that's my fear. Trying to let them help each other. I'm like 'What if it confuses someone even more?' Not that I don't confuse them sometimes. But that whole fear of releasing all of that to them" (post-interview 2nd observation cycle, May 10, 2018). This statement contradicted her earlier stated beliefs about teaching and learning mathematics, and made it difficult to achieve the learning environment she said she wanted. Through additional probing, it became clear that while Kay had the goal for students to self and peer assess, she did not really have the structures in place for them to do so. It might be argued that that structures were not in place because of a misalignment along the congruence dimension. Both SAAL and CI encouraged the development of student agency and autonomy. Kay desired to protect her students from confusion and mistakes; she wanted learning to be straightforward and safe. Because she lacked congruence between her goals and the innovations, she lacked instrumentality with the procedures and structures.

What is meant by "self-assessment"? Through further conversation, as ideas bandied about, it seemed as though Kay's understanding of student self and peer assessment might still be forming. Much of what she came up with was more for her own analysis of student comprehension, as opposed to having the students be reflective of their learning. And mathematical content still reigned supreme, and ultimately what she kept returning to. I wondered again if there was a hierarchy to Kay's learning goals, with the mathematical content goal outweighing anything else, and this influenced her practice.

During the pre-interview for the second lesson observation, Kay and I had discussed the development of a self-assessment, or reflection sheet. This would focus on how the students

communicated their mathematical ideas with their peers and how consistently they felt they used featured academic vocabulary (pre-interview 2nd observation cycle, May 9, 2018). In this way, the self-assessment was tangible, which was high on Kay's list of priorities. But the students' responses would attend to several of her other identified goals, such as mathematical discussions centered on justifications and their mathematical content knowledge, albeit in a roundabout way.

However, during the post-reflection, when I inquired as to why I did not observe the assessment sheet used in the lesson, in addition to stating she ran out of time, Kay replied, "I struggled with that. Right away, I go back to the math content. But I can't get away from that. I'm like 'Why not? It's a math lesson. Aren't they assessing themselves on the content?'" (post-interview 2nd observation cycle, May 12, 2018). Kay wanted a self-assessment that directly tied to the mathematical content of the lesson.

> To me, if they can explain how they know a copy's a scale copy of the original, then they kind of self-assess themselves. They went through to explain that yes, this was half of – these corresponding sides were half of each other, but then this other corresponding side wasn't half. So, it couldn't be [a scaled copy] because they [corresponding sides] all have to be halves. (post-interview 2nd observation cycle, May 12, 2018)

Kay's definition of self-assessment was closely tied to her mathematical content goal for this lesson; use corresponding parts of figures to explain how a scale factor relates to a figure and its scaled copy. She struggled to accept anything else that did not directly attend to the students' mathematical content knowledge as fitting the bill of self-assessment. The proposed reflection sheet that focused on students' interactions and collaborative skills as opposed to their content knowledge was incongruent with Kay's established definition of assessment.

In a final attempt to reframe student assessment as something larger than grasping

mathematical content knowledge, I brought up the concept of participation quizzes as a possibility for Kay's third lesson observation. We discussed what they were, how they were conducted, and the idea that they were "one way to communicate to children which behaviors their teacher values and encourages actions that minimize status differences. So I'm wondering if you can use this to double-dip" (pre-interview 3rd observation cycle, May 14, 2018). I proposed that participation quizzes were both a way for Kay to highlight the ways in which she wanted the students to interact and a public venue for self and peer feedback. She could also notate other aspects of the mathematical discussions that she wanted the students to emulate. In the long run, this would support her students in achieving her desired mathematical content goal. Kay was tasked with thinking overnight how she might use participation quizzes in the lesson.

Kay did not use a participation quiz in the third observed lesson. I did not have high hopes of seeing the quiz in action, as I did not think Kay had been convinced that it was an instructional practice that could help her achieve her learning goals. Congruence between the practice and her goals had not been established.

Yet, she was still concerned about her assessment goal as she did not feel that her students had made much progress: "I tried to use the term self-assessment more. And then I had to throw it [the term self assessment] in there [during the lesson] because then it made me realize, no, you do push the kids to think about their thinking but you just don't say self-assess"(post-interview 3rd observation cycle, May 17, 2018). Kay believed that she was pushing her students to self-assess, but that she had not labeled it that way for them. She felt that if she stating she wanted the students to self-assess, the students would be able to comply. Yet, "as I was going around, looking at their work hearing their discussions it didn't seem like they were self-assessing. Because what they were doing [with the content] didn't even make sense" (post-

interview 3rd observation cycle, May 17, 2018).

Kay went on to describe why she believed the lesson to be a "flop" (post-interview 3rd observation cycle, May 17, 2018). She had purposefully selected a warm-up problem that was different from the one suggested in the curriculum materials, because she felt it was more closely related to the mathematical content of the day (pre-interview 3rd observation cycle, May 14, 2018). However, the students struggled with the task far more than Kay had anticipated. She described how she tried to redirect them to use tools [a protractor] or draw representations to help them make sense of the problem, as well as use part A to make sense of part B. She verbally reinforced that she "needed [the students] to pay attention and focus" (post-interview 3rd observation cycle, May 17, 2018). These assists were perfectly reasonable, but what might have been missing was an element of self-assessment, for the students to be able to make sense of why the suggestions Kay was providing might help them move forward. She verbally reinforced that she was listening for students to assess, but that was as far as it went. Given that Kay had not established any structures for the students to be successful in this aspect, this was not surprising.

> Equally frustrating for Kay was the lack of attainment of the mathematical content goal. Okay, what went well? We did math, wait, wait. With air quotes, *we did math*. Did I meet my learning goal of understanding that multiplication not addition is used to make scaled copies? Well, if I look at the work we did today, no I didn't fucking meet the goal. (post-interview 3rd observation cycle, May 17, 2018)

It seemed as though not even the quantity of mathematics completed could make up for the lack of understanding that Kay felt her students had at the end of this lesson. Kay was discouraged by the end of the third lesson observation cycle, but this was perhaps an opening to move forward. Given that many of Kay's instructional practices were in service to her mathematical content

goal, if she felt that her content goal was not being achieved, she might be more open to addressing the goal in other ways.

Kay's "Final" Definition of Complex Instruction

Towards the end of the semester, Kay found herself "more confused about what CI" was (post-interview 2nd observation cycle, May 12, 2018). She came in to the project believing she had a clear understanding, but by the end of the lesson observation cycles, her perspectives and understandings had shifted. Roles and norms were not addressed, however, Kay had plenty to say in regards to CI tasks and addressing status.

Tasks

Kay's perspective on groupworthy tasks had changed. She recognized that tasks were important, but as a conduit for the conversation that students engaged in around the mathematics of the task.

> You talk to some people and they're focused on tasks. 'The task is part of it' I said, but honestly it's more the discussion that's occurring, the student sharing of ideas. Right? Isn't that what's making it? When we first did this I'm like 'Okay. It's the task. It's the task. It's the task.' And now I'm like 'No, it's not the task. It's the conversation.' (post-interview 2nd observation cycle, May 12, 2018)

Kay's focus of CI being defined by the presence of a task seemed to have waned as she recognized that how students interacted with and communicated about the task was of more value. In her comments, there is a stronger connection between the task and the norms for doing mathematics, and a new connection between tasks and student status.

> And now, talking through this, I'm like Okay, now it's training the kids to have deeper conversations. And conversations where 'Yeah, I hear what you said' and valuing the

> conversations. Does that make sense? Then they wouldn't need to come say, 'Miss, I need you to tell me who's right here'. It's 'No. You guys value what each other's saying. You trust your teammates'. (post-interview 2nd observation cycle, May 12, 2018)

Kay spoke to the students' understanding of how to have rich, mathematical conversations, and of them valuing their group members' contributions. There was also a reoccurrence of the idea shared in the first lesson observation cycle, in that Kay did not want her students to rely on her as the authority in the classroom, but to trust in each other, however this time, Kay did not model herself as a part of the conversation.

Status

Kay still struggled with the way her educational context seemed to work against equalizing status among her students, especially when it came to students' association of grades with high status.

> There's always the grades because I mean to this very, today, report cards. 'What'd you get in math?' And honestly, I don't know if that's something as teachers we can ever get them completely away from because they are, that's – I think just a competitive nature of some of them. And of course, like I've told them, 'You don't have to talk about your grades to anyone that you don't want. You can just say, Oh, I did good or you know.' So there's that part. I don't think that changed because to the very end they're still 'What'd you get?' (post project interview, May 23, 2018)

Kay felt that there was not much she could do to dissuade some of her students to not focus on grades, given how prevalent that idea was in society and how competitive she believed some of her students to be. Despite her attempts to try to downplay the importance of grades, the idea persisted with her students.

While Kay felt there was not much she could do in regards to grades, she did feel that she could address the way students listened and reacted to one another in the moment. Pinpointing an area Kay felt was within her locus of control, Kay talked about her ability to assign competence to some of her students.

> That was something that I was more mindful of. And I notice with Luke in particular, like there were a few times where I would tell his group, 'Well you guys are asking me a question, and you have Luke here who's answering it for you. Will you guys listen to him?' So, I think that kind of helped especially one student, Amy, who I would say mathematically was a more proficient student, would actually, 'Oh, that's true.' Do you know what I mean? And whether it was to appease me, or she really finds value. Like I would hear her, 'So Luke, how did you get this one?'. (post-project interview, May 23, 2018)

Kay wasn't sure if Amy was just picking up on what she thought Kay wanted to hear, or whether Amy truly understood that Luke had some valuable insights, but either way, Kay viewed it as a win. At the very least, Kay figured the model Amy served as a student of high status, helped the cause of raising Luke's status in the eyes of his peers. Additionally, Kay's comments demonstrate her cognizance of the students of low status. At the start of the study, her conversations had been centered only on students assigned high status.

Kay also spoke to the idea of how she might have reinforced some students' status in the way she reacted and talked to them. She recognized that at times when she was frustrated she was short with certain students, and made comments that might cause the students to shut down.

> I would say I still have a lot of work on making sure the statuses kind of are leveled and that my students kind of learn to value everyone's opinion. It's truly something I need to

> kind of fix on myself. Like make sure I don't, how do I tell you, speak my internal feelings so the kids pick up on it. (post-project interview, May 23, 2018)

This was a shift in from where Kay started. Initially, Kay did not give any indication of how doing the grade checks and data displays might have reinforced status issues in her classroom. While she still labeled those issues as something outside of her control, she acknowledged that she did play a role in how status was perceived in her classroom. Kay understood that she was a part of her classroom environment and that the students looked to her for a guide as to how to interact with each other.

Where Kay Ended

> I am not even going to say the words 'complex instruction'. CI is just engaging students in conversations about their math, having them share their ideas to kind of show their understandings. Of course, that's one part of the conversation, but then also knowing how and being willing to listen to the ideas of others to kind of build on their own knowledge base. (post-project interview, May 23, 2018)

For Kay, CI had come less to be defined by the individual components, and more about student discussions and interactions to promote mathematical understandings. Kay's definition of CI was less defined and yet moved closer to an idealized version of the instructional practice over the course of the semester. Figure 6.7 depicts the idealized version at the top. The bottom left figure depicts where Kay started in her understanding of CI, which is contrasted with Kay's ending understanding portrayed on the bottom right.

Throughout the semester, Kay's views on norms and roles did not change. Therefore in the visual on the right, these two components maintain the same size, shape, and shading as how they started. Given the fact that Kay realized at the end of the semester that tasks did not define

CI, this component is shown smaller than originally. Kay's comments at the end of the semester also revealed a connection between tasks and addressing status issues, so these two components are now connected. Lastly, given Kay's revelations that she contributed to students' status assignments, but that she also was being mindful of addressing status issues in the class by assigning students' competence, the component is larger in the visual on the right and is shaded in. Addressing status played a more prominent role in Kay's understanding of CI, and was present in her instructional practices.

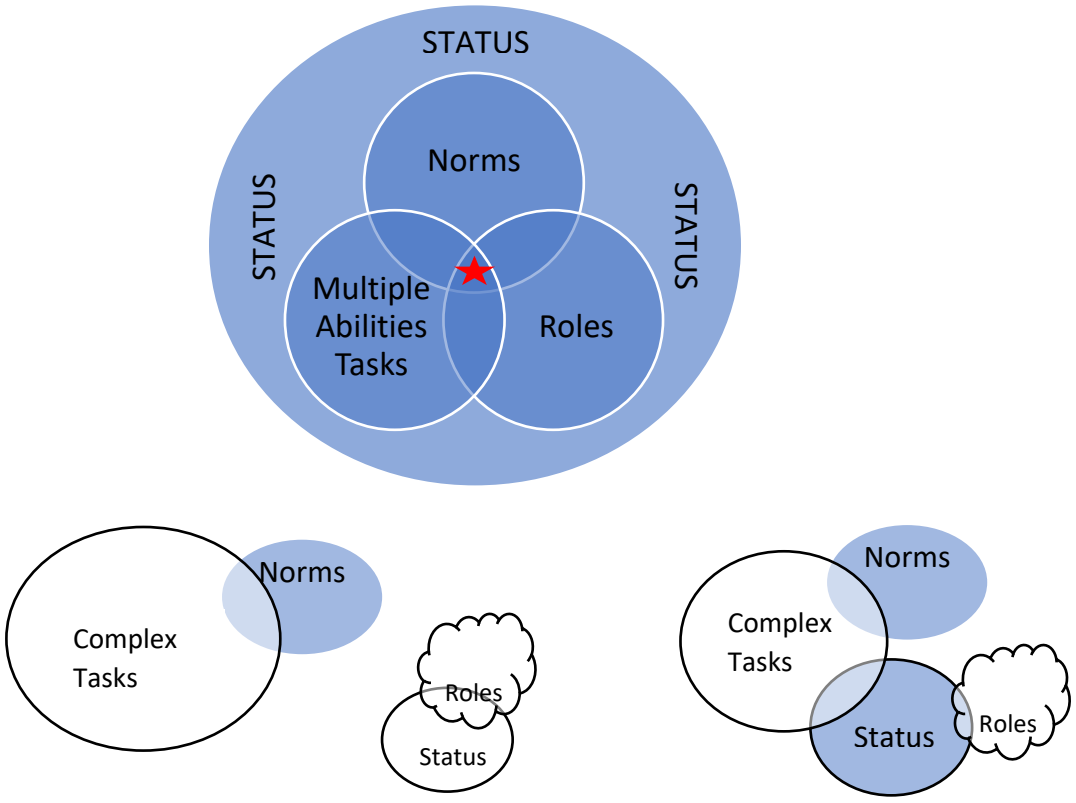


Figure 6.7. Three Definitions of Complex Instruction.
An idealized definition of CI top, center. Kay's starting definition of CI on bottom left and her ending definition on bottom right.

Discussion

Throughout the semester, Kay struggled due to a misalignment along the congruence dimension between what she perceived to be competing instructional practices and the goals within her instructional context. Kay was quite focused on students' self and peer feedback stemming from the district initiative, SAAL. However, Kay's enacted practices revealed a hyper-focus on her students' achievement of mathematical content goals which seemed connected to completion of an adequate number of tasks. This study sought to examine Kay's integration of the components and tenets of CI into her instructional practice as a way to attain her learning goals. The three instructional goals of equitable access to learning (CI), self and peer feedback (SAAL), and accomplishment of tasks (mathematical content goals), should, in theory, assist each other. CI components could establish structures for students to provide productive self and peer feedback, which could advance the students' understanding of the mathematical content leading to satisfactory completion of such tasks. However for Kay, each goal was seen as compartmentalized from the other and competing for her attention. Each practice was incongruent with the others, which led to a lack of instrumentality on how to enact each, and contributed to a high cost of investment.

Kay is an interesting case that adds to the analysis of the impact of the congruence dimension on practicality theory, in what she teaches us about congruence between innovations, and the resulting impact on instrumentality and cost of enactment. She also help helpful in us making sense of incongruencies that lay within a teacher, between their beliefs and the innovations they are required to take on.

Congruence

Revisiting one of Kay's prior statements, "So, we move on to something new and we're not supposed to forget this [formative assessment], but we're never able to become [masters]" (post-interview 2nd observation cycle, May 10, 2018), I cannot help but draw a parallel between Kay's own learning and her beliefs about students' learning. Kay was uncomfortable moving to a new innovation, or even an advanced level of an innovation, as SAAL was the next step to the formative assessment course, until she felt she had completely learned the first innovation. Learning was once again presented as acquiring concepts in a linear fashion. There was little to no room for messiness, and multiple opportunities for practice were essential. Kay's beliefs about learning, for both her and her students, seemed to create a misalignment along the congruence dimension of her implementation of the suggested innovations.

We can draw further parallels between Kay and her students, and her beliefs about learning when we consider the following. Again in an earlier quote, Kay talked about the students having agency and being aware of their own learning. "To move them forward and make them more aware of their own learning so they can kind of learn, and especially when they get to middle school and high school, *how to ask for help* [emphasis added]" (post-interview 2nd observation cycle, May 12, 2018). This statement does not seem congruent with the intentionality of formative assessment, SAAL, or CI. A tenet of all three innovations is for students to learn how to help themselves as learners. Through each of the practices, the students learn to identify where in the learning process they are stalled, but also to have developed the skills and processes to be able to help themselves. The ultimate goal is not for students to recognize that they need help and then turn to someone to fix it. The students "asking for help" seemed to refer back to the teacher-centeredness of Kay's instructional practices and her beliefs about the learning process. Kay really wanted to be in control and she was not comfortable with

student autonomy and interdependence. She believed students needed her to guide their learning. This created an misalignment in the congruence dimension with the innovations and Kay's beliefs about teaching and learning.

But this idea of a guide in the learning process seemed to be echoed in Kay's comments about her own learning and internalizing of the SAAL practices.

> Now pulling that in because we've had two years you know how to do this, or a year and a half. Now, let's work together on SAAL this year. The whole student assessment – yes, we met in small groups what? Twice, three times? But there wasn't that conversation where I don't even know if I understood it. Do you know what I mean? That could just be me being me, but I can honestly say I didn't get much out of SAAL this year. I completed it – I haven't even completed the last module. I did the work but it wasn't meaningful to me. (post-interview 2nd observation cycle, May 12, 2018)

Kay stated that due to the low number of meetings, she was unable to understand the practice of SAAL, and draw meaning from the practice. Without that meaning, the misalignemnt in the congruence dimension between the practice and Kay's goals and beliefs would persist, which would result in her not being able to successfully integrate the practice into her instructional routines.

Kay's struggles with enacting the various innovations was in part due to a misalignment with her beliefs and goals, but it was also in part to not fully understanding the innovations she was being asked to enact. Kay provides us insight into the teacher as a learner. When a teacher doesn't understand an innovation, we can end up with problems with congruence that are not about true incongruence between teacher beliefs and the innovation but are more about incongruence between the teacher's understanding of the innovation and the teacher's beliefs. So

we have to check with teachers to see what their understanding is of the innovation because if we have not done a good job of setting up the innovation and communicating its foundations, we could end up with unnecessary incongruences. A teacher's learning is just as important as the learning of students. Just as the innovations encourage student agency, we must also remember the element of teacher agency. As teachers are being asked to change their instructional practices, they want to feel that there is room for practice, room for errors, and time for exploration. They need to understand how the practice might benefit their students as well as themselves, and they want more explicit connections to how the practice fits into the larger picture of the school and district environment. Without keeping teacher learning forefront, we might continue to struggle to attain the desired level of student learning.

Instrumentality Influenced by Congruence

It seemed as though Kay's theory of learning was fundamentally incongruent with each of the innovations, and because of this, Kay struggled to envision the required student-centered environment and procedures for enactment. Based on observed practices and her reflections throughout the semester, Kay conveyed a belief that students learned through straightforward engagement with the mathematical content. She was quite concerned that any state of confusion her students entered would interfere with their learning, therefore she made sure to keep them tightly reigned in. Her comments conveyed the belief that mathematics was logical and could be cracked simply by conversing with others. Through student collaboration, Kay believed mathematical misunderstandings were easily identified and corrected. Because of these beliefs about mathematical learning, her ideas about how students collaborated around the mathematics and provided feedback took on a different structure than intended by the innovator developers, and caused Kay a lot of dissatisfaction with her teaching and the innovations themselves. The

misalignment along the congruence dimension regarding Kay's beliefs about teaching and learning impacted the instrumentality of her enacted procedures.

In providing opportunities for students to collaborate around the mathematics and engage in rich discussions in the first lesson observation cycle, Kay felt she had sacrificed some of her mathematical content goal, in that students did not complete the tasks she had planned. Structuring conversations in a way so that students would not get too off-track helped Kay feel she was closer to attaining her mathematical content goal, which she felt set students up for traditional characteristics of success, such as better grades and higher test scores. However, this focus came at the expense of students taking ownership of their learning and the ability to construct feedback, which were the purposes of the innovations. Kay seemed unable to integrate the various innovation components so that the practices supported one another and ultimately helped her attain her learning goals. In fact, by the end of third lesson cycle, Kay stated that none of her goals were met and her frustration was quite apparent in her talk.

It might be difficult for many teachers, as it was for Kay, to orchestrate a student-centered learning environment. Given the intense amount of pressure teachers are under regarding the various accountability systems, it is not too much a specious leap that some tend to equate success with high quantities of solved problems and achievement on standardized assessments. One of two shifts might positively impact the instrumentality of a teacher-centered classroom environment, neither of which is easily done. Either the teacher puts their trust the process the innovation is supporting, or the systems of accountability need to be dismantled. Within the teacher's locus of control, is trusting the process. Teachers' beliefs in the congruence dimension influencing their procedures and instrumentality. As we saw with Lee, a belief that time and energy spent now will be beneficial in the long run, in regards to student learning and

attainment of instructional goals. Kay did not exhibit such faith. As accountability measures increased, the inclination became to more tightly control the teaching environment, and mastery of any innovation become more elusive.

Cost

While Kay admitted early on that she knew she made her job more difficult by constantly changing grade levels, she also felt she was not solely to blame in her implementation struggles. Kay reflected on the fact that each year there seemed to be a new focus initiative coming down from on high, and that she was never able to fully master one before the year was up and attention was diverted.

> And that's something that I found. Last year, we did all this work on formative assessment, which we completed at the end of the school year. And then this year it's like 'Okay. Now it's SAAL'. So, we move onto something new and we're not supposed to forget this [formative assessment], but we're never able to become [masters] – it's just another part of compliance. 'Do this by this date. Do this by this date.' But like next year they are already talking about how it's formative *and* this. But what's gonna take precedence in the building? And what are they going to focus more on? And am I gonna keep where I want to go with the student conversation, student feedback, the self-assessment which I think those would be the most powerful for me to work on with my students? To move them forward and make them more aware of their own learning so they can kind of learn, and especially when they get to middle school and high school, how to ask for help. (post-interview 2nd observation cycle, May 12, 2018).

Kay's speech was revealing in terms of how she perceived decisions made by school and district administrators. Mandates were given, foci shifted annually, and much of what she felt she did

was driven by compliance. There was a perceived negative social cost for Kay to not toe the line, despite the fact that she had identified a need to stay with her current focus as that was what would be most beneficial for her students and their educational futures. Kay felt as though she was just getting a handle on the work from last year, but in an effort to stay in compliance, she would need to move on to the next innovation whether she was ready or not.

> I felt formative assessment, that whole module, was more useful to me as an individual teacher than what I'm doing right now. Maybe it's because I – And I know what we're doing right now in SAAL does have to do with student self-assessment and stuff, but I guess I felt like 'No, I still needed to work on this where next year we do this again?' I honestly don't even know if I wanna do it again. (post-interview 2nd observation cycle, May 10, 2018)

Given that Kay had identified what would be most beneficial to further her skills as an educator and what she felt would be most beneficial to her students, there was an increased cost to moving to a different innovation, and Kay was unconvinced it would be worth it.

> And I know they're like 'Well, Kay, you get paid'. I said, 'I know. We get paid and that's great, but if I'm not getting anything out of it' – And I guess for me I'm the type where yeah, the money's nice but at the same time if I'm not getting anything out of it – and I'm not saying this is not useful. I'm saying this is me. I haven't found a way to wrap my head around it and the money doesn't mean much to me because I'm not finding the relevance. Does that make sense? (post-interview 2nd observation cycle, May 10, 2018)

The foundational core of practicality theory is that teachers will adopt innovations that bring them closer to their learning goals. For Kay, despite the fact that she was getting paid for her participation in SAAL, which mitigated some of the cost of implementation, it did not seem as

though it was enough to mitigate the incongruence with her beliefs that SAAL was not relevant to her instructional context. She went along with it because it was required and she got paid, but the cost was really high when compared to the perceived benefits in her instructional context.

As teachers experience struggles in the enactment of innovations, their confidence in their ability to meet instructional goals might wane and frustrations escalate. Financial compensation is often a go-to when extra time or effort is required of educators. By no means am I dismissing the necessity of such compensation. However, if the only perceived benefit by such educators of an innovation is the financial gain, there most likely will not be shifts to instruction. Kay showed us that teachers who do not understand the relevance of an innovation to their instructional context nor feel the benefits are substantial to themselves or their students, will comply to negate negative social costs, but most likely will not integrate the innovation in their instructional context. Money can be supplemental motivation, but it cannot supplant motivation.

Teachers have various factors that influence their instructional practices. Achievement of instructional goals and promoting student learning are near the top of the list, but are not the only factors at play. Teachers might manage multiple innovations to varying levels of understanding, Understanding of the procedures and purpose of an innovation, as well as how that innovation connects to the bigger picture can support a teacher's enactment. For Kay, this understanding was a struggle that she was not able to reconcile throughout the course of this study. The misalignments in the congruence dimension regarding her beliefs, goals, and the various conflicts she perceived among the innovations rendered her effectively stalled.

However, in a bright spot of the semester's instruction and reflection, Kay was able to make headway in regards to attending to issues of status in her classroom. While Kay identified early on that there existed status differentials among her students, she did not necessarily view it

to be an issue. Throughout the course of the semester, Kay became more conscientious of how status issues might be impacting her students' learning, and was able to recognize more instances of status coming into play. Given that status is a key tenet to CI, this could be considered a big win in terms of Kay's progress. The self-reflection Kay applied to her teaching and student interactions allowed her the opportunity to grow and refine her instructional practices in a way that positively affected learning.

CHAPTER 7

CROSS-CASE ANALYSIS

In this chapter, I discuss patterns across the three cases as they relate to the practicality theory framework. These patterns compare and contrast the struggles and successes the featured teachers experienced across the three dimensions of instrumentality, congruence, and cost as the teachers worked towards integrating the instructional practice of CI into their classroom environment. Table 7.1 summarizes the areas of enactment that were featured in the findings chapters. The table helps highlight the influence that the congruence dimension had on teachers' enactment of CI; both as a hindrance to their enactment, as well as providing an avenue to enactment. Several of the areas of overlap will be discussed in the following sections.

Teacher	Areas of Enactment	Dimension in which Experienced a Struggle with Enactment	Dimension in which Applied a Solution in Enactment	Dimension in which Experienced an Initial Success with Enactment
Meg	Roles / Student Participation	Congruence	Instrumentality	
Lee	Roles / Student Participation	Instrumentality	Congruence	
Meg	CI & Existing Demands (Goals & SC)	Congruence	Instrumentality Congruence	
Lee	CI & Existing Demands (Traditional)	Congruence	Cost Congruence	
Kay	CI & Existing Demands (SAAL)	Congruence Cost		
Kay	Student Centeredness	Instrumentality		
Meg	Classroom Environment, Tasks			Instrumentality, Cost

Table 7.1. Comparison of Cases Across the Dimensions of Practicality Theory.

Congruence

The congruence dimension has several aspects by which teachers might judge the practicality of a given innovation to determine its use in their classroom. This dimension proved to be perhaps the most impactful when it came to the three teachers featured in this study.

(Mis)Alignment with instructional goals. One aspect of the congruence dimension of practicality theory of an innovation refers to the alignment of an instructional practice with the teacher's current goals (Doyle & Ponder, 1977; Janssen et al., 2013). An instructional practice that contributes to a teacher's instructional goals has an increased probability of being incorporated into the instructional routine.

In Chapter 3, as part of my description of how the teachers and I co-constructed their Heuristic Goal System (HGS) maps, I described a pattern I recognized in regards to the learning

goals the teachers identified related to their lesson segments. As I continued to ask "why", in an effort to reveal the teachers' overarching goals, I noticed that the goals could be categorized into mathematical content goals, mathematical practice goals, and goals for student interactions, which I called CI or groupwork goals. The teachers generally had several sub-goals related to each of these categories, but they ultimately fed into a larger goal for each concept.

In the findings chapters for Meg, Lee, and Kay, many of their anticipated learning goals for the different lesson cycles were outlined. The mathematical content goals changed across lessons and teachers, depending on where the teachers were in their instructional scope and sequence. However, the mathematical practice goals and the CI goals remained fairly consistent for each teacher throughout the course of the study. Additionally, there were similarities across the teachers in both of these categories (see Table 7.2). For their mathematical practice goals, a common thread was the desire for students to justify their reasoning. With the exception of Meg's first lesson cycle, the language from mathematical practice standard number three was identified as a top priority for all the teachers in all observed lessons. For the CI goals, Meg consistently stated she wanted her students to work collaboratively and for everyone's contributions to be considered. Along the same lines, Lee's CI goals were consistently listed as increased student participation. Kay, being very focused on SAAL, wanted a particular type of student participation and collaboration, in the form of self and peer feedback.

	Observation Cycle 1	Observation Cycle 2	Observation Cycle 3
Meg	• content goal: Work with operations of fractions with unlike denominators. • mathematical practice (mp) goal: Apply prior learning in a real-world context, look for and make use of structure. • groupwork goal: There are different ways to solve problems and we don't all work same way.	• content goal: Additive volume, division with double-digit divisors. • mp goal: Make sense of problems & persevere. Justify thinking & critique others'. • groupwork goal: All ideas are solicited and some connection is going on between ideas. Respectfully listen to contribute.	• content goal: Shore up understanding of perimeter and area of a rectangle. • mp goal: Make sense of problems. • groupwork goal: Students will work collaboratively and everyone will participate.
Lee	• content goal: Understand the relationship between multiplication and division. • mp goal: Justify their reasoning. • groupwork goal: Everyone participates.	• content goal: Solve problems in a real-world context using the four operations. • mp goal: Make sense of problem and justify their reasoning. • groupwork goal: Make sure everybody has status and is involved. Increase the level of accountability that the students have so everybody is engaged.	• content goal: Work with operations of fractions with unlike denominators. • mp goal: Persevere on unfamiliar tasks • groupwork goal: Honing skills on group questions and everyone participates.
Kay	• content goal: Solidify the meaning of absolute value within the context of sea level. • mp goal: Justify their reasoning • groupwork goal: Work together and discuss the mathematics, but more specifically, for the students to provide self and peer feedback, as opposed to looking to her for redirection or confirmation.	• content goal: Scale factor and corresponding attributes. • mp goal: Justify reasoning. • groupwork goal: Building student confidence through discussions with peers, group discussions and self-assessment.	• content goal: Scale factors, making scaled copies. • mp goal: Justify reasoning. • groupwork goal: Push 'em to self-assess. (pre-interviews from all participants, 2018)

Table 7.2. Summary of Instructional Goals.

During Meg and Kay's pre-interviews it did not seem as though any one category of anticipated instructional goal outweighed another. However, when it came to enacted instructional practices, it seemed as though the mathematical content goal rose to the top in terms of focus, and thereby, attainment.

With Meg, the mathematical content goals became the focus almost through default, as she did not have enough structures in place to support the students to work collaboratively and ensure that everyone's ideas were heard. Throughout the post-interviews of the three lesson cycles, Meg and I repeatedly came back to issues of over-participation and under-participation. In Chapter 4, I recounted the conversation Meg and I had about Andy's group and the feedback the group members provided. Andy did all the math, as reported by himself and his peers. However, his group was able to submit a completed task. During the second lesson observation reflection, several other groups were discussed in regards to missed opportunities for students to work collaboratively. Once again, finished products were submitted by the end of the allotted time. In each of these examples, while the groupwork goal was left unattained, the meeting of the content goal and task completion somewhat ameliorated Meg's perception of success.

Kay's practices and reflections revealed a clear hierarchy of goals, with mathematical content coming out on top. Throughout the course of the study, Kay measured lesson success by the quantity of problems the students completed. The teacher-centeredness of Kay's instructional practices also leaned towards the mathematical content goal. In an effort to not allow the students to get too far off track, Kay steered her students towards correct processes and answers. What was observed in Kay's practices mirror the findings of Grant et al. (1998), in that her goals leaned more towards the efficient of lesson completion as opposed to fully supporting student learning. Kay's mathematical content goal even bled into the CI goal, in that she proposed a

content-focused assessment as opposed to allowing students to provide feedback on their collaborative processes. The parallels between Kay's hierarchy of goals and the teacher's hierarchy of beliefs reported in Raymond's (1997) study in Chapter 2 is striking. Raymond found the teacher in their study had conflicting beliefs about mathematics. What the teacher believed about content called for a different set of instructional practices than what they believed about teaching and learning, but based on what was enacted, the beliefs about content were more primary. For Kay, she had several lesson goals. Based on her enacted practice, the goals around content mastery seemed to be more primary than the goals on collaboration.

Lee took a different approach from the other two teachers. While she identified goals in all three categories, Lee put a premium from the start on her CI goal. She admitted that her main focus for the observed lessons were on student participation above all else and that the math content would follow. In Chapter 5, in regards to her second lesson observation cycle, Lee stated

> While the math today wasn't as meaningful as I'd hoped for, I still feel as if it's time well spent because they were interested, engaged, involved in some math, and practicing important social/life skills. It basically failed but I'm okay with it, because I know it will lead to a quality experience for them soon. (written reflection 2nd observation cycle, March 28, 2018)

Lee acknowledged the hierarchy in her learning goals, but also recognized how the goals were interdependent and could support each other. Lee's approach to her instructional practice shows how one might make short-term concessions in service to the greater good. For Lee, sacrificing the achievement of her mathematics content goal now to focus on student participation would result in long-term achievement overall.

For all three teachers, there was an implied congruence between their anticipated learning goals and the components and tenets of CI. However, for Meg and Kay, as their practices unfolded and the mathematical content goal took on more importance, they developed an incongruence between CI and their learning goals. This is not to imply that CI does not support students in their mathematical understandings. Quite the contrary is true, as was demonstrated in the successful achievement data shared from Railside School (Boaler & Staples, 2008). But, for Kay in particular, it became clear that she measured success by the students' completion of numerous problems, which caused her to struggle with implementing CI in her classroom environment. A main obstacle in implementing reform-oriented practices is teachers' beliefs about mathematics teaching and learning, and for Kay, we see this play out in her first lesson observation cycle (Ross, McDougall, & Hogaboam-Gray, 2002). Despite the increased quality of conversation her second class engaged in, she was drawn to the idea that the first class got farther in the lesson, as a mark of success. For Lee, since she went in to the lessons having identified that a focus on increased student participation was her main instructional goal, she was able to maintain her congruence between her goal and her practice from what she anticipated to what was enacted.

This finding highlights another layer that comes into play as teachers contemplate changes to their instructional practices. Because instructional practices have connections to learning goals, it is important for teachers to not only be aware of their learning goals, but acknowledge if there is a hierarchy to those goals. They might not anticipate a practice being impractical but if it turns out their main focus is a goal that does not align with a dimension of practicality theory they may end up not adopting the practice.

As the three teachers articulated connections among their beliefs about teaching and learning mathematics, their learning goals, and their anticipated and enacted instructional practices, their understanding of CI grew. Meg and Lee ended with clear definitions of all the components of CI, and they were all evident in their practice to some degree. Kay made a smaller change to her instructional practices, but had been able to make some headway in addressing status issues in her classroom. Perhaps what the three teachers show us is that greater gains can be made in one's instructional practice when they are more aware of what elements of an innovation are practical for their context.

(Mis)Alignment with existing demands of the teaching environment. In addition to judging an instructional practice in terms of its alignment to one's instructional goals, a teacher will evaluate how well an instructional practice will integrate with existing demands in their teaching environment. As various initiatives are introduced to the instructional context, these programs and practices can conflict with one another. If a proposed innovation is going to interfere with elements of pre-existing mandates, a teacher is less likely to work to incorporate the practice into their environment.

The teachers in this study, like most teachers, did not work in isolation. Their classrooms were housed in schools, and those schools were located within districts. Each environment brought their own initiatives and goals to the table, and teachers often found themselves juggling several innovations at once. With focus diverted in several directions, and applying similar learning theories to our teachers that we apply to our students, it makes sense that teachers might not immediately fully understand the innovations they are choosing to do or being asked to do. This lack of understanding can hamper the process of enacting the practices, especially when

teachers feel that practices are in direct conflict with one another. A conflict of practice was present in each of the three teacher cases.

As previously stated, all three teachers had knowledge of CI as an instructional practice. In the case of Meg, she had been working on incorporating CI in to her classroom environment for four years. On the other end of the spectrum, Kay and Lee had been exposed to the concept, and had actively tried to incorporate the practice during the time of exposure, but it had since fallen by the wayside. The three teachers had the basic ideas of CI down, but were a bit rusty (or perhaps, never exposed) when it came to the various nuances of the practice.

At the same time, their school district had an initiative that teachers would engage their students in an on-going process of formative assessment. This process included sharing and co-constructing learning goals and success criteria with the students, and for students to be actively engaged in providing self and peer feedback. All three of the teachers were Teacher Leaders at their sites, and as such, were required to heavily engage in learning about and implementing this process in their classrooms over the last two years.

Despite the longevity of exposure to both innovations, neither could be said to be mastered by any of the teachers, and there were elements of both that were misunderstood. These misunderstandings resulted in misalignments in the congruence dimension between enacting CI and the existing demands of their teaching environment.

For Meg and Kay, there was a perception that enacting CI would conflict with the requirements of the formative assessment process. In Chapter 4, I described Meg's struggles with the compliance of having a posted learning goal and success criteria, but also wanting to honor the inquiry that is central to a CI task. However, in the learning goals that Meg provided her

students, it seemed as though she was not following the intention. Her learning goals outlined what students would do as opposed to what they would learn.

For Kay, it was difficult to have her engage in any of the components of CI, as she was focused on the idea of students providing self and peer feedback to each other. However, she also seemed to want that self and peer feedback directly related to mathematical content and struggled with the idea that students could provide feedback on collaborative skills. In the end, there were actually very few opportunities for students to provide that feedback, either formally or informally, as indecision and pacing won out.

CI and formative assessment practices, as described by Heritage (2016), are not unrelated, and in can fact support one another. The goals behind the elements of formative assessment are to provide student agency of learning and positively impact their identities as capable learners. These are similar to some of the broader goals of CI. Parallels across the two innovations can be seen in various aspects of the practices. Listing out the smartness a task might require from the different group members maps nicely onto posting success criteria - a list of how the students know they have successfully achieved the learning goal. Providing peer feedback in the formative assessment realm is supported by the discussion structures that are made possible through the norms, roles, and equalization of status of CI.

However, Meg and Kay struggled to see these and other connections between the two innovations. The innovations were incongruent in their minds, and their practice remained compartmentalized for the most part. Meg was willing to engage with CI due to her involvement in this study. Her cost was lower to start, given her prior history with the practice. It did not require as much effort or resources to enact CI along with the formative assessment work, and while she struggled to integrate the two, her perceived benefit on her everyday teaching demands

and expected return of investment for student outcomes was greater than the cost she perceived For Kay, despite her involvement in the study, the cost was too great, and it became a zero-sum game. She could not focus on anything other than the SAAL work. Because she did not have some procedures already in place, the effort and required resources to add CI into the mix was greater than her perceived benefits. She was heavily invested in SAAL and was not willing to lessen her attention on that practice and risk the benefits she hoped to achieve.

Lee's lack of understanding around CI became problematic as well, as she expressed an incongruence between enacting CI and the existing demands of her teaching environment. While the formative assessment practices were a component of Lee's instruction, that was not her road block. Her struggle lay with the difference in instructional approaches between CI and a more direct-instruction teaching model she understood to be expected. Lee believed she did not understand CI well enough to justify its use in her classroom, and this factored in to her decision to play it safer when it came to observed instructional strategies.

However, Lee's social cost of enacting CI was largely mitigated by her participation in this study. She spoke to the accountability of her participation and how that not only gave her the freedoms to experiment with various aspects of the practice, but also kept her at it throughout the course of the semester. Lee acknowledged past practice of letting things go too soon.

While the teachers had plenty of exposure to both CI and the formative assessment practices of SAAL, understanding is a fluid concept that can be influenced by experience. As the teachers continued to enact and reflect on the practices, the perceived misalignments in the congruence dimension might not have seemed so impassable. As their experience with the innovations increased, so would their understandings. Shifting focus from teachers, towards administrators who largely influence professional development experiences around innovations

and instructional practices, there is additional room for improvement. Those who exist outside of the instructional space but influence that instructional space, have an obligation to be better informed about how the existing ecology of the classroom environment will impinge upon the innovating. At a minimum, teachers need opportunities to reflect upon how their classroom ecology influences their thinking about innovations. This is essential information for administrators to have as part of their reflection. There is equal ownership in enacting and reflecting for the purposes of understanding.

Cost

The third dimension of practicality theory is one of cost. A teacher will weigh the effort and required resources to enact the innovation, against the expected return in everyday teaching demands and positive impact on student outcomes (Ponder & Doyle, 1977). There can also be a comparison of social costs to social rewards. Social costs might include students', colleagues', and administrators' reactions to the new instructional practice. A teacher might analyze how incorporating a new practice might affect their status and social position where a greater risk of opposition will most likely result in the innovation not being enacted.

The costs associated with enacting CI did not seem readily apparent in the teachers' anticipated practices, but became more relevant through enactment. Circling back, if Meg and Kay defined positive student outcomes as more math problems correctly solved by the end of the class period, then enacting CI practices might jeopardize that outcome. In the heat of the moment, they were not willing (Kay) or able (Meg) to sacrifice those student benefits. Lee went in to the lesson cycles knowing the nature of her tasks was making attainable success for her math content difficult, due to the varying levels of mathematics needed and the missing information to the contexts. So while she had a mathematics content goal, her expected return on

her everyday teaching demands was met by focusing on her CI goal. She believed that time invested now on student participation would pay off later and transfer over to the students' attainment of future mathematical content goals.

Intersections across Dimensions

As helpful as it might have been for each dimension of practicality theory to stay pure, there were instances where there was overlap. The three dimensions were not as compartmentalized as they could have been, and there were instances of overlap in the teachers' enacted practices and how they chose to enact CI.

One component of CI that rose to the top in terms of focus was roles. All three of the participants struggled with enacting them although Meg's and Lee's struggles were far more pronounced than Kay's. Also of note was the interplay between the teachers' lesson goals and their practices. Due to the nature of this study, I was able trace instructional decisions these teachers made in regards to their anticipated and enacted instructional practices, in an effort to make sense of factors that they considered as they contemplated changes to their instructional practices.

Instrumentality and congruence. In the findings chapters for Meg and Lee, I discussed their struggles with enacting roles in their classroom environments. Meg began the study with a fairly clear understanding of the purpose of the roles, but stated she did not use them. Lee did not have as clear an understanding of the roles, and they were also not present in her current instructional practices. Both Meg and Lee underwent a process of self-bridging when it came to roles in their anticipated instructional practices. Meg struggled with roles due to a lack of congruence between the component and her perception of herself as a teacher. Her solution to increase the presence of roles in her classroom focused on instrumentality, which was not at the

heart of the issue. Because of this mismatch between problem and solution, Meg was not able to move her practice forward in terms of roles. Lee also struggled with roles, however her situation could be argued as being the reverse of Meg's.

As a reminder, the instrumentality dimension of practicality theory as stated in chapter 2, is an innovation's instrumentality is the specification of enactment of how an innovation takes place within the existing classroom environment (Doyle & Ponder, 1977). It is the converting of an innovation from principles to procedures, from theory to practice (Janssen, Westbroek, & Doyle, 2014). As the teachers in this study enacted particular component of CI in their classrooms, they tended to gravitate towards components that aligned with their existing classroom structures, and that they understood in clear, succinct ways. We saw the teachers struggle when they could not envision particular components within the constraints of their teaching context.

Referring back to the findings in chapter 2, Meg made a conscious decision to not use the roles during her first lesson cycle. During the second lesson cycle, Meg anticipated using the roles of facilitator and resource manager. During the third lesson cycle Meg had reverted to not using roles again, but anticipated the students would use talking sticks as a way to equalize participation. At the end of the study, Meg anticipated the use of roles with her students the following year, although, she discussed modifying at least one of the roles to be participation captain, whose main responsibility would be tracking group members' participation, in an effort to ensure equity.

In contrast, Lee anticipated using all four CI roles during the first lesson cycle. During the second and third lesson cycles, Lee anticipated using just the resource monitor, and focusing her attention on discussion protocols that would assist in making sure all students participated.

Lee anticipated future use of the roles, once she understood them better and felt more confident in conveying their purpose and use to her students.

As Philipp (2007) noted, beliefs serve as a filter for ideas. Meg believed herself to be a loose teacher and her classroom to be unstructured. Roles, filtered through Meg's beliefs, were too confining and added a layer of structure to her classroom with which she was uncomfortable. In contrast, Lee believed that the founders of CI would not include roles as a core component of CI unless they worked. They were there for a reason. Filtering the idea of roles through that belief led Lee to the conclusion that the issue with enacting roles lay *with her*, in that she did not understand them well enough yet to facilitate her students' use of them.

For both Meg and Lee, there was a misalignment between the anticipated enactment of CI roles and their own classroom context, but along different dimensions of practicality theory. For Meg, the main conflict with roles was one of incongruence between what she believed roles did to her classroom structure and her perception of herself as a teacher. Meg chose to address her incongruence with roles by fiddling with their instrumentality. Instead of reflecting on her beliefs about who she was as a teacher or analyzing how the roles might contribute to her learning goals, Meg chose to change the way roles were enacted. She looked to altering the procedures of the roles, and introduced talking sticks and a new role of Participation Captain. However, these modifications did not have any impact on the instructional practices, for two reasons. First, they did not address the heart of Meg's issue with roles (i.e., they provided structure where she wanted flexibility). And second, the new procedures did not have any alignment with existing classroom procedures. The students were not familiar with the new procedures, so they were unable to successfully enact them.

Unlike Meg, Lee had a strong alignment with roles in the congruence dimension, in that she had the utmost faith in the credentials of origins of the innovation and believed in the prior successful reported enactments of CI. Lee struggled with envisioning the procedures of roles in her classroom. She suffered from a misalignment along the instrumentality dimension. Lee addressed her misalignment, but via the same dimension where the misalignment occurred. Because Lee understood roles to be a way to increase student participation, and because Lee had an existing classroom procedure of a discussion protocol that addressed student participation, Lee chose to focus on that. This modification had an impact on Lee's instructional practices, in that the discussion protocol aligned with Lee's existing procedures and was a means to an end for her instructional goal. What is especially interesting to note, is that despite the differentiation in paths, both teachers ended up with a focus on student contributions to mathematical conversations; Meg with her participation captain and Lee with her discussion protocol.

These two teachers' struggles with roles is enlightening, as the cases illustrate the complexity of factors teachers consider as they contemplate changes to their instructional practices. For one component of one instructional practice (roles as a part of CI), the teachers internalized it in completely different ways (no thank you, please vs. it must work but not sure how), had different practicality dimensions that interfered with their enactment of the component (congruence vs. instrumentality), but used similar strategies for addressing that interference (procedural modifications), to varying degrees of success.

This finding highlights some of the many factors that come into play as teachers contemplate changes to their instructional practices, and is demonstrative of the various points in time at which an instructional practice can break down. In order for teachers to be able to make sense of the adoption process, they need to make sense of what they deem practical and

impractical about the suggested instructional practices. Meg is a very thoughtful, reflective, innovative teacher, and yet she could not identify the real source of her problem with roles, which became a barrier to her implementation. Meg shows us how a teacher might see benefits to an innovation, but be unable to realize those benefits because the teacher is not realizing and therefore is not addressing what is making the innovation impractical. Meg, being who she is, provides a best case scenario of how difficult it can be for teachers to really make sense of some of their instructional decisions. Lee provides a best case scenario of a teacher who not only sees the benefits and constraints of an innovation, but addresses the constraints in order to reap the benefits. Both teachers' experiences support Knapp and Peterson's (1995) claim that a change to teacher beliefs is not an event, but a process. Meg exemplifies the more task oriented process in an attempted to align her practices with her beliefs. Lee exemplifies how beliefs can gain momentum as students make gains based on the application of instructional practices.

Meg and Lee's decisions around roles reveal one of the multi-layered aspect of teachers' considerations as they contemplated changes to their instructional practices. For these two teachers, beliefs they held about themselves, their context, and the instructional practice factored into their decisions. Of equal importance as beliefs in the evaluation of practices through the lens of practicality theory, are the learning goals a teacher wants to attain. Practicality theory works on the premise that teachers make judgments about the practicality of innovations and the ability of the innovation to help them attain their learning goals.

CHAPTER 8

DISCUSSION / CONCLUSION

I began this dissertation recounting a professional development series I facilitated years ago, where I perceived that the participants failed to take on the instructional practice of Complex Instruction. Despite my best efforts to attend to what I understood to be shortcomings in providing professional development, the end results and impacts to classroom practices were far from my expectations. This experience led to the current research goal of making sense of the factors that teachers consider as they contemplate changes to their instructional practices.

In the literature review, I introduced the theoretical framework of practicality theory (Doyle & Ponder, 1977) that outlined the three dimensions by which teachers make decisions regarding the integration of instructional practices into their existing classroom environments. Evaluating a practice according to its instrumentality, congruence, and cost, a teacher will measure the magnitude of change required to implement the practice. Using the analysis from this framework, while attending to teachers' learning goals, current practices might be incrementally shifted, or bridged, towards a more idealized version of the suggested innovation (Janssen, et al., 2013; Janssen et al., 2014).

In Chapter 3, I outlined my research methods. I described the context of the study, including my positionality, the research setting, and focal participants. I outlined my sources of data and my process of analysis.

Throughout the next three chapters, I told the stories of Meg, Lee, and Kay. I shared the connections they made between their beliefs and goals to their anticipated and enacted instructional practices. I used the framework of practicality theory to analyze what factors supported and interfered with the alignment between their beliefs and goals and their

instructional practices along the dimensions of instrumentality, congruence, and cost. I was able to capture the ways in which the teachers bridged (or did not bridge) their current enacted practices towards a more idealized version of Complex Instruction.

In chapter 7, I summarized the claims from the three findings chapters, as well as looked across the three cases to make connections about what impacted teachers' instructional practices.

In this chapter, I will address each of my research questions, and situate my findings within the current literature, and then discuss additional implications and limitations.

Summary of Findings for Research Question One

The first research question of my study was:

What connections do teachers articulate among their beliefs, their goals and the practice of Complex Instruction?

For all three teachers, they initially stated that generally their instructional practices aligned with their beliefs and that their intended practices would result in achieving their learning goals. The descriptions the teachers gave of their prevailing learning environments were reminiscent of reform-oriented, student-centered, instructional practices (NCTM, 1991; NCTM, 2014; Schoenfeld, 2004; Wood et al., 1991). Meg, Lee, and Kay described personal productive beliefs about mathematics teaching and learning similar to what was outlined by NCTM (2014). Thanks to a district-wide mandated innovation, all three teachers were very cognizant of identifying daily learning goals (Heritage, 2016). The three teachers were all familiar with CI as an instructional practice, although to varying degrees. Meg's understanding seemed the most advanced at the start of the study, with three components having clear definitions and two components being evident in her current practices. Kay started with two components having clear definitions and one component being evident in current practices. When Lee began the

study, she did not have any of the components evident in her current practices, and only had a clear definition of one component.

Taken as a whole, the cases of the three participant teachers suggest connections among their stated beliefs and goals and the instructional practice of CI. The most prominent connection was related to the teachers' goals regarding student participation. The teachers believed that the various components of CI could support them in achieving their instructional goals. For example, mathematically rich tasks encouraged student conversation and lent themselves to justification of reasoning. The norms and roles of engaging with the mathematics helped support an equitable learning environment through equalizing issues of status. The teachers continued to refine their implementation of CI, even when their implementation sometimes failed in ways they did not expect. Moreover, the three participants ended the study making implantation plans for the following school year based on their experiences. The instructional practice of CI seemed to be a powerful reinforcement of the teachers' own beliefs and goals regarding teaching and learning.

Summary of Findings for Research Question Two

The second research question of my study was:

What factors support and what factors interfere with teachers' alignment of their enactment of Complex Instruction with their goals and beliefs (including factors that might improve alignment and those that might maintain alignment)?

This question focused on the struggles and success the teachers had in enacting CI in their classroom environments, and specifically, looking at those struggles and success through the lens of the three dimensions of practicality theory. My research indicated that although there were elements of CI that could be classified in all three dimensions in terms of supporting and interfering enactment, the congruence dimension seemed to be the most impactful to teachers'

practice. Within the congruence dimension lay internal core constructs, such as a teacher's beliefs about teaching and learning mathematics, as well as their perceptions of self. These constructs are often deep seated and are difficult to adjust. Additionally, there also lies an external element of existing demands on the teaching environment. Often times, these existing demands are often outside of teachers' locus of control. While difficult to attend to, neither end of the spectrum in terms of the congruence dimension is untouchable, as demonstrated by the teachers in this study. However, changes within these aspects might be incremental and take a considerable amount of time to fully realize. We saw examples of this in the self-bridging moves Meg and Lee did in terms of their use of roles in an effort to increase student participation. We also saw this in regards to how each of the teachers addressed the conflict they perceived between enacting CI and how that practice was influenced by the existing demands in their environment. This suggests that factors that interfere with enactment of CI can be overcome, as long as the approach is done in service to the teachers' instructional goals.

Assumptions and Contributions to Research on Practicality Theory

The existing literature on practicality theory, and on the bridging methodology specifically, has been presented as a facilitated process between researcher or teacher-educator and teacher (Janssen et al., 2013; Janssen et al., 2014). In an effort to better meet a teacher's learning goals, the facilitator helps the teacher incrementally move their practice towards a more idealized version of the innovation. The findings of this study add a level to the practicality theory research that does not currently exist. The research on practicality theory focuses on the role of a facilitator in supporting changes to teacher practice, but this study shows that teachers can and do make changes themselves to their practice. Meg and Lee self-bridged. These teachers proposed their own incremental changes to their instructional practices. These changes shifted

the teachers' practices closer to the intentionality of CI, while at the same time brought the teachers closer to attaining their learning goals.

I stated in Chapter 2 that we must operate under the positive presupposition most teachers are intrinsically motivated to refine their craft in order to affect positive change for students' learning (Guskey, 1986). The cases of Meg and Lee demonstrate this well, in that they took on the bridging process without guidance from me. They saw a need and an opening and took it.

Kay's case demonstrates a more targeted bridge, if you will. In her first observation cycle, Kay went along quite willingly with my proposed suggestions to bridge her current practice towards a more idealized enactment of CI, in service to her goals. The suggested changes to the instrumentality of her practice were slight enough that Kay could envision them in her classroom and enact them immediately, thus having little impact to the cost dimension. Additionally, framing the changes in regards to attainment of stated learning goals, addressed a piece of the misalignment in the congruence dimension. This act of facilitation, while not having lasting effects on Kay's practice, did allow her the opportunity to experience a lesson enactment in a manner that she might otherwise not have done so.

However, a facilitator is probably helpful in this process to more directly and efficiently steer a teacher towards their learning goals. For example, Meg, left to her own devices, addressed a congruence problem with instrumentality solutions. This might not have happened had someone intervened. While a facilitator might be helpful to this process, it is certainly not necessary, and it might be interesting to further study how we might help teachers in refining their abilities to self-bridge.

Assumptions and Contributions to Research on Complex Instruction

As stated in Chapter 2, while there is research on the success of the use of CI at Railside, and there are isolated articles on implementation, there is not much that has been done to document the process by which teachers take on CI. What has been of particular interest in this study, and has been mirrored in several smaller projects, are issues around implementing roles (Eli & Hackett, 2019; Hackett, Eli, Salcido, & Quihuis, 2019; Hackett et al., 2019). It might be helpful to better understand how teachers tend to perceive roles, what might be some successful strategies for overcoming obstacles with roles, and a bottom-line, what is the purpose for roles. While Meg and Lee taught us that there is more than one path to role enactment, it would be helpful to further study what components of roles appeal to teachers on a more general level, and what seem to be roadblocks.

On one end of the spectrum, roles seem to be appealing in terms of their tangibility and high-visibility. For both Meg and Lee, the role cards themselves were a primary focus at the start of the study. Meg pulled the cards out of a closet as we discussed their possible use during the pre-interview of the first observation cycle, and Lee spoke to how she liked that the role cards gave every student a job. There is perhaps something concrete to having the role cards on the desks and it is somewhat satisfying that a visitor to the classroom might see the role cards and think "This teacher is using CI". The instrumentality of roles seem easy enough. Assign roles. Put out cards.

However, student roles, specifically as a component of CI, do not exist in a vacuum. In actuality, student roles in CI have more to do with the congruence dimension of practicality theory as opposed to instrumentality, in that they are a way to convey beliefs and values. If the roles are not aiding students in contributing towards the work in intellectually significant ways, they are not serving their intended purpose, and they might be considered a roadblock to

enactment and discarded by teachers (Featherstone et al., 2011). Roles in CI are one strategy to equalize status issues that hinder student learning. The connection between the roles and status seemed to get lost along the way for the teachers in this study, and this could be an area of further study.

Implications

Often times, when teachers contemplate enacting a new instructional strategy, they envision the end goal. Based on a video clip of the perfect enactment, they imagine what could be in their own classrooms. They believe researchers, professional development providers, and instructional coaches as they rave about how beneficial the new strategy could be for students and teachers alike, and how it is easily implemented if one just follows the prescribed guidelines.

But, more often than not, the teacher goes back to their classroom, tries out the instructional practice, and things go wrong. Perhaps the teacher missed a crucial step. Perhaps these same hiccups happened in the model classroom as well, but we were not privy to the down and dirty; only the shining-end example was shared. Perhaps there was a lack of congruence between the credentials of the innovation and the reality of the classroom where the innovation was being applied. For whatever reason, maybe even for all these reasons and more, instructional practices more often than not do not go the way they were advertised or anticipated, and more often than not, teachers give up, revert, and feel unsuccessful.

The process by which teacher change typically takes place is extensive (Borko et al., 1997; Foster, 2017; Heck et al., 2008; Patton, Parker, & Tannehill, 2015). Unfortunately, it is perhaps not always considered in the design and execution of many professional development experiences (Phillip, 2007). Are teachers willing participants in professional development? Are teachers' goals for instruction and learning taken into account when the professional

development program is determined? Are teachers involved in the planning of the professional development experience? How is the professional development situated within the context of teachers' lived realities of instruction? These are just several questions for consideration when designing a professional development experience. The answers might impact the ability of the experience to affect change.

This study helps broaden the scope of focus for professional development providers, teacher educators, and district curriculum personnel. It is already established in the literature that PD experiences are more impactful to positively changing teachers' practices when they are a process, not a singular event (Borko et al., 1997; Heck et al., 2008). What this study speaks to is the importance of continuously supporting teachers extends beyond the PD experience. We could benefit to follow through on the messages that are sent about good teaching of students with our teachers. We need to be checking in to see how our students (the teachers) are making sense of the ideas, practices, etc. that are being shared. This becomes even more so important when there are multiple innovations being promoted. The alignment between multiple innovations should be explicitly stated for teachers to avoid any perception of competing expectations. A component of professional development that should be added would be one that addressed the instrumentality of enacting multiple innovations, so that teachers understand how the procedures in one innovation might support or lead to the procedures of a different innovation. If teachers do not understand the innovations, they cannot make sense of the implementation.

For example, Kay did as well as might be expected. She was presented with several innovations and practices and tried to make sense of them. However there was little formative assessment on how Kay was doing in her journey of understanding and implementation of the various innovations. She had a lot to balance and integrate, between the suggested practices, her

beliefs, her goals, and her instructional context. Without some regular check-ins to help her make sense of how they all supported each other, the components most directly under her locus of control (beliefs and goals) will, and did, win out. Just like all learners, teachers need the opportunities to develop their discourse around an innovation.

To this end, as professional development providers, teacher educators, and district curriculum personnel design PD, there is an additional layer to keep in mind. The research on PD has already shown that for experiences to be most effective they should be of sustained duration, be collaborative, and provide coaching (Borko et al., 1997; Foster, 2017; Heck et al., 2008; Patton, Parker, & Tannehill, 2015). The component of effective PD that this study seems to directly speak to is that of reflection on the part of the practitioner. Through the mapping of instructional practices via the HGS and then the identification of practices that supported goals through the TIA, teachers in this study were given tools that allowed them to analyze their craft in a new way. They became, in general, more cognizant about what they were doing and why they were doing it as they worked through the semester. It might also be a powerful move towards shifting teachers' instructional practices if they were to become fluent in the language of the dimensions of practicality theory. Being able to specifically name what about an intervention is not working might be the first step in addressing that conflict.

All three teachers in this study were phenomenal educators, representing the very best the field has to offer. If they experienced such trials and tribulations in enacting an innovation that they were on board with from the get go, it speaks to the larger picture, when we have a variety of teachers and enactment of innovative practices is not always done by choice. Refining our support in regards to the best case scenarios presented in this study might bring us closer to being of better service to the larger field of educators.

Limitations and Future Research

The goal of this case study research was to explore teachers' instructional practices, as they contemplated changes to their practice in an effort to better meet their stated goals. The case study methodology allowed an in-depth, extensive exploration of these three teachers' practice, during this particular time of this particular school year. There is more that might be learned through further research involving different teachers, time frames, and contexts.

This study did not begin when the teachers' CI journey started, but rather came in at the middle, and after an admitted hiatus. The in-depth focus on CI as an instructional practice had occurred several years prior to this study. While the teachers were knowledgeable about CI and were willing participants, I can't help but wonder if their path towards changing their instructional practices might have been a little narrower and straighter if their initial learning had been closer to the time of these in-depth observations. Additionally, these three teachers were initially exposed to the practice of CI by an admitted novice. It would be interesting to trace teachers' initial adoption paths of CI as they learned from an expert in the field.

Another limitation to this study was the time frame. Three observations cycles over a period of a semester was perhaps not the best way to capture changes over time. In some instances, several months passed between observations, and while we did have the built in partial cycle of enact, reflect, repeat that Borko et al. (1997) found to be impactful, it lost some of its oomph as the months dragged on. Shorter, more frequent cycles might have better captured the teachers' thought processes and might have resulted in more visible shifts to their instructional practices. It also might allow us as mathematics educational researchers to better understand the multitude of factors that are in play as teachers contemplate changes to their practices.

A third limitation to this study was my focus on teachers' implementation (or not) of CI in service to the achievement of their stated instructional goals. While a teachers' goals will influence much of what happens during instruction, there are a multitude of other factors that contribute to what plays out in a classroom environment, and how and if an instructional practice is enacted. Previously shared factors might be Lee's admission at the start of the semester that she avoided doing CI because it was easier to not have to explain herself to her site administration. We also saw Kay's unstated instructional goal of classroom management influence her practice during her first lesson observation cycle.

There were other occurrences throughout the semester, in all three classrooms, that I chose not to focus on, given my intentionality of honing in on the teachers' attainment of their instructional goals. There were interruptions to by announcements over the intercom. There were several occasions where students experienced melt downs, either as residual effects from recess or stemming from frustration at the given task. Schedules and pacing calendars were thrown off due to illnesses, field-trips, and an unprecedented district closure. This increased the pressures the teachers felt for their students to perform well on district benchmark assessments as well as the standardized state assessment. However, I admit that these factors most likely influenced the teachers' practices and enactment of CI.

Lastly, my positionality was a huge limitation in this research study. I recognized that the teachers might tell me what I wanted to hear, but I did not anticipate the anomaly in my research methodology at the prospect of being able to "fix" an instructional practice. To get a better idea of what factors impede teachers’ progress towards change, an impartial researcher, who had no personal vested interest, might get a cleaner perspective of teacher considerations.

Conclusion

This study perhaps raised more questions than it answered. While this study helped me make sense of the factors teachers consider as they contemplate changes to their instructional practices, it also exposed the myriad of factors under consideration. Unearthing what these factors are might be helpful in planning of future professional development experiences, however, they also bring forth the idea of how crucial follow-up is to any professional development that focuses on changing instructional practices. Through the examination of the data through the dimensions of practicality theory, I learned just how crucial a dimension congruence is. Cost and instrumentality, while having positive or negative influences on a teacher's ability to enact a new practice, live outside of the teacher. Through additional resources or support, many of the barriers that might lie within those two dimensions can be addressed. Congruence, with its focus on teacher beliefs, learning goals, and perception of self, is a much harder misalignment to overcome. It's not impossible, but would require continued and frequent support to help the teacher make sense of and align inconsistencies between the practice and their internal aspects.

Much like the teacher study group presented in Chapter 1, the teachers of this study did not fully adopt the tenets and components of CI into their instructional routines. Unlike at the end of the teacher study group though, I have more of an understanding, as do the teachers themselves, as to why this is. The lens of practicality theory was a helpful analysis tool for me to make sense of the factors and decisions with which the teachers grappled. The HGS and TIA were helpful for the teachers in beginning to make incremental shifts to their instruction as they worked to incorporate more of CI in the attainment of their goals. Continued support of these teachers, and others, with these analytical tools, might help support personnel move the needle on reform-oriented mathematics teaching practices.

APPENDIX A

Initial and Post-Project Interview

Beliefs Data

1. How would you define mathematics?
2. What do you think mathematicians do when they do math?
3. How does mathematics factor into your daily life? What kinds of math do you do?
4. What do you think is the best way for students to learn math?
5. In what ways do you have an impact on students' learning of mathematics?
6. What are the three most important characteristics of good mathematics teaching?
7. How do you know when you have had a successful mathematics lesson?
8. What do you think is the most effective way to teach mathematics?

Teaching Practice Data

1. What is a typical mathematics lesson like in your class? What are you doing and saying? What are your students doing and saying?
2. What kinds of tasks are your students engaged in during mathematics class?
3. How would you describe the mathematical learning environment in your room?

Teachers' Perceptions of Relationships Between, and Influences on, Beliefs and Practices

1. What most influences your mathematics beliefs?
2. What most influences your practice?
3. To what extent do you believe your mathematics beliefs are reflected in your practice?
4. Tell me an example of how your beliefs influence you practice.
5. Do you feel your mathematical beliefs and practices are mostly consistent?
    1. How do you keep the consistency? or What keeps from being consistent?

Complex Instruction

1. What does CI mean to you? What do you think of when you hear CI?
2. What role does CI play in your mathematics class today?
3. Do you think the students rank each other?
4. Is there anything else you would like to tell me?

(adapted from Raymond, 1997)

APPENDIX B

Pre-Interview for Lesson Observation Cycles

1. Describe the segments of this mathematics lesson. What are you are going to do; what is the sequence of events that will take place, from *bell to bell*? (i.e. rvw hw, intro new topic, seatwork, etc)

2. Why is your mathematics lesson sequenced in this particular way?

3. What purpose does each segment of your mathematics lesson serve; why is each segment important? (i.e. rvw hw is a way to make sure students are keeping up and focus their attention)

4. For (this) goal you identified, why is it important? (i.e. keeping up with work is important because progress in learning builds on prior learning, students need external pacing)

5. For (this) goal you identified, why is it important? (i.e. content is learned sequentially and therefore requires steady application of attention over long periods of time)

6. How is each lesson segment enacted? (i.e. hw is rvw by students exchanging papers and calling on a student randomly to provide answers)

7. Looking at the representation, which goals-means relationships are aligning in a manner that you want? Mark them with a grey line. Which goals-means relationships conflict? Mark them with a black line.

8. Evaluating your heuristic goals system representation, which goals do you feel confident about achieving? Why?

9. Evaluating your heuristic goals system representation, which goal would you like to work on? Why?

10. How might integrating the new innovation/instructional practice help you achieve this goal? Describe what that might look like?

(adapted from Janssen, Westbroek, Doyle, & Van Driel, 2013)

APPENDIX C

Written Reflection

1) What do you think were the strengths of the lesson?
2) Is there anything that surprised you during the lesson? If so, describe this in more detail.
3) Is there anything that you wished would have gone differently during the lesson? If so, describe this in more detail.
4) If you taught the lesson again, what changes would you make?

APPENDIX D

Post-Interview for Lesson Observation Cycles

1) What was one instructional goal that you were focused on for this lesson?
    a. How do you think the lesson went in terms of meeting your identified goal?
2) How would you compare the enactment of this lesson to the same lesson from last year (or a similar lesson)?
3) What did you learn about children's mathematical thinking during the lesson?
    a. To what extent did children's strategies /thinking/ confusions align with what you anticipated that students would do? Provide an example if possible.
4) What part or parts of the lesson challenged you the most in your ability to teach this lesson? Was there anything in the lesson that made you feel anxious?

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